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RELATION OF INSECTS TO HUMAN WELFARE[1]

By H. A. GOSSARD

Long ages before the earliest mammal appeared on earth multitudinous individuals representing diversified types of insect life had found congenial homes in prairie, forest and desert. if such terms may be correctly applied to landscapes differing in most respects from any which have ever been seen or named by human kind. Above the earth, on its surface, in its caves, and on and in its waters these creatures fed and multiplied as now. Well back towards the morning twilight of geological history, in the Silurian age, and in greater numbers in the Devonian, when the fishes represented the culminating point reached by the animal kingdom and a true forest vegetation for the first time clothed the youthful world, the types represented by

[1]The following paper was compiled by the writer for the information of the Century Club, a small association of literary, scientific and professional men of Wooster, O. The only merit, if any, to which the paper can lay claim is that of an example of popular writing that helps to mold a friendly sentiment among intelligent and influential men, and eventually brings enlarged resources for work and investigation to the economic entomologist. A careful scrutiny of the composition will disclose among the authorities and papers which have been drawn upon the following in particular, from which, in some cases, quotations have been made with but little or no change from the original text:

Second Report United States Entomological Commission on the Rocky Mountain Locust.

Review, in Science, by Doctor Howard of the History of Economic Entomology for Fifty Years.

The Gypsy Moth, by E. H. Forbush.

The Brown-Tail Moth, Fernald and Kirkland.

Flies and Ticks as Agents in Distribution of Disease, by F. V. Theobald.

The Economic Status of Insects as a Class, by Dr. L. O. Howard.

the cockroach and the mayfly heralded the oncoming myriads of their congeners which yet endure and probably will endure as long as the world sustains life. One of our entomologists in forecasting the likelihood of the long survival of the insect class breaks forth in the following poetic language: "When the moon shall have faded from the sky and the sun shall shine at noonday a dull cherry red, and the seas shall be frozen over and the ice-cap shall have crept downward to the equator from either pole, and no keel shall cut the waters, nor wheels turn in mills, when all cities shall have long been dead and crumbled into dust, and all life shall be on the very last verge of extinction on this globe, then, on a bit of lichen, growing on the bald rocks beside the eternal snows of Panama, shall be seated a tiny insect, preening its antennæ in the glow of the wornout sun, representing the sole survival of animal life on this, our earth,—a melancholy 'bug.'"[2]

The long period through which the Class Insecta has existed has caused it to develop an almost incredible number of species, some among them adapted to every condition of climate and topography on the globe. Excepting the microscopic forms of animals and plants, the number of all other species of living things added together, mammals, birds, fishes, reptiles, animals of whatsoever class, trees and plants total together but a small fraction of the number of species in the insect world. The number of species is variously estimated at from 2,500,000 to 10,000,000, with the probabilities favoring the latter figure as the more nearly correct. Assuming the maximum figure to be correct, in what a field does the entomologist find himself! Suppose that he attempts to familiarize himself with each species so that he will recognize it the next time he sees it. Since his task is obviously great, we will start him at it at the age of five years and allot him five minutes in which to study each species, giving one half of the time to a male specimen and one half to a female. Lest he should become lazy, we will provide him with electric lights and keep him working day and night, and lest he should become fat, we will forbid him to eat except as he is able to snatch mouthfuls from the five-minute intervals during which he is expected to fix in his memory the anatomical characters, color patterns, etc., which differentiate each species from every kindred one. Working in this manner and at this rate, the rains of nearly one hundred summers will have fallen on his roof before the last representative of the long procession of insects has passed before him, and he is permitted to step outside his door to renew his childhood and behold a real live grasshopper

[2]W. J. Holland, end of Moth Book.

lamp or a gorgeously winged butterfly dance over the meadows. And if we accept the smaller estimate as correct, we have only to reduce the daily working hours to twelve, and allot ten minutes instead of five for the study of each species to obtain precisely the same result. And yet there are people who are surprised if a professional entomologist fails to promptly recognize every specimen submitted to him for identification! The descriptions of about 300,000 insects have been written and published. The undescribed forms are, many of them, small, and many inhabit but partially explored regions of the earth, such as the tropics of South America and Africa.

Fortunate it is for mankind that the insect world is a house divided against itself, otherwise the greenest and most fertile lands in the world would shortly become lifeless deserts. Except for the check put upon insect multiplication through warfare within the insect household, by which one species of insect destroys its relatives, no informed naturalist would expect the survival of the human race for a longer period than five or six years. Not only would man's food supply be appropriated by his insect enemies, but it would be impossible for him to withstand the withering march of malaria, yellow fever, typhoid, bubonic plague, sleeping sickness and other maladies transmitted through insect carriers, that would consume like a devouring fire and leave in their track a desolation compared with which the plagues of Egypt were happy visitations, though these were in part insect outbreaks. The fecundity of insects is amazing. Huxley estimated that a single aphis or plant louse would produce in ten generations, if no mishaps occurred to cut short the natural life of any of her descendants, a mass of organic matter equivalent to the bulk of 500,000,000 human beings or the whole population of the Chinese empire. The common apple plant louse has normally about eight generations in one season, the greater proportion of the individuals failing for various reasons to reproduce, the chief cause of repression of multiplication being the work of insect parasites and predaceous insect forms, which for so long a time and with such certainty of result have transformed a potential peril into a well-balanced condition of safety that we give but scant attention to the aphids, and only occasionally find it advisable to turn on them our batteries of insecticides, to do clumsily and expensively what nature does without noise or change from her customary processes.

Insects render themselves obnoxious to man in two ways: First, by partially or wholly destroying his crops and harming his domesticated animals; and second, by attacking him directly, either inflicting pain upon him or inoculating him with disease, some forms of which

are enervating and others dangerous to his life. From the earliest historic times he has suffered from both forms of injury, but naturally the early records refer most frequently to famine conditions resulting from crop destruction, the causes of which were obvious to all observers, while the office of insects as carriers of disease was, in early days, very imperfectly understood and, for the most part, not suspected at all. Among the plagues visited upon Egypt in the days of Moses was one of lice "in man and in beast," and swarms of flies were promised to Pharaoh in these words: "I will send swarms of flies upon thee and upon thy servants and upon thy people and into thy houses; and the houses of the Egyptians shall be full of swarms of flies and also the ground whereon they are." The plague of locusts is said to have "covered the face of the whole earth so that the land was darkened; and they did eat every herb of the land and all the fruit of the trees which the hail had left; and there remained not any green thing in the trees or in the herbs of the field through all the land of Egypt."

To merely enumerate the locust invasions paralleling the Egyptian outbreak that have since been recorded in various parts of the world would require many sheets of manuscript, but let us pause long enough to glean a few quotations. Pliny, the Roman naturalist, writing from 50 to 79 A. D., says: "Their numbers are so vast that they quite darken the sun. Those from Africa are the ones which chiefly devastate Italy; and more than once the Roman people have been obliged to have recourse to the Sibylline books to learn what remedies to employ under their apprehensions of impending danger." Beauplan, writing of a swarm that visited the Ukraine in 1645 and 1646, says: "These creatures do not come in legions but in whole clouds, five or six leagues in length and two or three in breadth, and generally come from towards Tartary. These vermin being drove by an east or southeast wind come into Ukraine, where they do much mischief, eating up all sorts of grain and grass, so that wheresoever they come in less than two hours they crop all they find, which causes great scarcity of provisions. It is not easy to express their numbers, for all the air is full and darkened. In June, 1646, having stayed two months in a new town, called Novogorod, where I was building a citadel, I was astonished to see so vast a multitude, for it was prodigious to behold them, because they were hatched there that spring and, being as yet scarce able to fly, the ground was all covered and the air so full of them that I could not eat in my chamber without a candle, all the houses being full of them, even to the stables, barns, chambers, garrets and cellars. I caused cannon powder and

sulfur to be burnt to expel them, but all to no purpose, for when the door was opened an infinite number came in, and the others went out, fluttering about. And it was a troublesome thing when a man went abroad to be hit on the face by those creatures, sometimes on the nose, sometimes on the eyes, and sometimes on the cheek, so there was no opening one's mouth but some would get in. Yet all this was nothing, for when we were to eat, these creatures gave us no respite, and when we went to cut a bit of meat we cut a locust with it, and when a man opened his mouth to put in a morsel he was sure to chew one of them. I have seen them at night, when they sit to rest them, that the roads were four inches thick of them one upon another, so that the horses would not trample over them, but as they were put on with much lashing, pricking up their ears, snorting and treading very fearfully. The wheels of our carts and the feet of our horses bruising those creatures, there came from them such a stink as not only offended the nose but the brain. I was not able to endure the stench, but was forced to wash my nose in vinegar and hold a handkerchief dipped in it continually to my nostrils."[3] Some of my hearers doubtless remember the devastation wrought in the states of the western Mississippi valley from the close of the Civil War until about 1876. So serious was the locust plague in some of the richest of these states that immigration to them was greatly discouraged, and the settlers already there were subjected to the severest privations. Every year local districts or great areas in the provinces of the British Northwest, in the Dakotas, in Minnesota and in neighboring states must wage vigorous warfare against some of the various species of grasshoppers, often piling the dead insects captured in the hopper-dozers in windrows and heaps of such extent that the air for miles is polluted with the stench.

The mighty power of destruction possessed by these insects when massed together may be inferred from the extent of a swarm passing over the Red Sea in November, 1889, which spread out over 2,000 square miles in area; and from the fact that in the island of Cyprus in 1881 1,300 tons of locust eggs were destroyed.

To instance other insects with extraordinary capacity for damage, the Hessian fly may be cited. It attacks wheat, barley and rye. Professor Webster estimated that the damage in Ohio for the season of 1900 alone amounted to more than $15,000,000. For the entire United States the average annual damage caused by Hessian fly is considered by the best informed experts to be about $40,000,000. The chinch bug is estimated to inflict an average annual loss of $7,000,000, on the

[3]Taken from Second Report U. S. Ent. Comm. on Rocky Mountain Locust.

wheat growers, or, if during the past fifty years any person could have appropriated to himself the wealth which this insect has destroyed he would be worth $350,000,000 with accrued compound interest and earnings to be added thereto, and could invite Mr. Rockefeller to take second place in the magnate row. The Mexican cotton boll weevil crossed the Rio Grande River into Texas in the early '90s and, advancing over the cotton-growing territory at an average rate of seventy-five to one hundred miles annually, has now reached Arkansas and the Indian territory on the north and the valley of the Mississippi on the east. "The damage it has done and the fears it has aroused in other cotton-growing countries have threatened a disturbance in the balance of trade for the entire world."[1] The damage inflicted by this insect during the seasons of its greatest abundance is estimated to have been from $15,000,000 to $30,000,000. In 1894 it damaged the crop in Texas alone to the extent of $8,000,000. The gypsy moth was introduced into America by accident in 1868 or 1869. A French naturalist, artist and astronomer, living at that time near Glenwood, Medford, Mass., was experimenting in raising silk with our native silkworms, and also imported European species for the same purpose. Among his shipments were the eggs of the gypsy moth and a gust of wind is said to have carried some of them through an open window. Mr. Trouvelot was greatly disturbed by the accident, and failing after diligent search to find the eggs, gave public notice of the calamity, much to the amusement of his neighbors, who were unable to understand his anxiety. During the first ten years after its escape no one, except Mr. Trouvelot, is known to have observed it. Twenty years after its escape, in 1889, the first extensive outbreak occurred. Since its first outbreak it has spread over extensive districts in Massachusetts, and has also appeared in the neighboring states of Rhode Island and New Hampshire.

A resident of the infested district in Massachusetts gives the following description of the ravages of the gypsy moth: "The caterpillars were so thick in the trees that you could hear them eating. They would get on the fences until they made them fairly black. They would crawl upon and into the houses. They would get inside somehow, and it was a common thing to see them crawling upon a table, and we have even found them on the beds. They would get under steps, stones and into old stovepipes, old cans, boxes, in short any place which afforded shelter. They crawled into the cellar windows. They were so thick on the street trees that people would walk out in the middle of the street, where there were fewer dropping down. It is no exaggeration to say

[1] Dr. L. O. Howard in Science.

that I have raked quarts of caterpillars off a tree. I have seen them crawling in great numbers on the rails of the Medford branch track. After a train had gone along the rails would be all green with their crushed bodies." Another writes: "Before public measures were taken in the matter, the foliage was completely stripped from all the trees in the eastern part of our town, presenting an awful picture of devastation and promising in a short time to kill every tree and shrub and all vegetation in any region visited by these creatures," which shows how inadequate individual effort was to cope with the subject.

The brown-tail moth, also scattered through the New England states, well nigh rivals the gypsy moth in destructiveness to vegetation and because of its barbed hairs, which are poisonous, it makes itself the more disagreeable of the two to human beings. One of the victims writes: "We were shockingly poisoned by the caterpillars of the brown-tail moth. They troubled us all summer. Every member of my family was poisoned. At first we did not know what they were. My little boy could not go near the insects without getting poisoned. Every time he went to pick cherries he would come down from the tree badly poisoned. If my baby went near where they were his face would break out into a rash. I was so dreadfully poisoned that I thought I had some frightful disease. My hands, face and arms were broken out with this rash. The caterpillars came into the house and even into the closets. They would get on the clothes hanging on the line and when these were worn they poisoned us."

The codling worm of the apple causes a yearly loss of $10,000,000 to $15,000,000. The San José scale causes the death of millions of fruit trees each year, and stored corn in the seven Gulf States alone is estimated to suffer damage from insects to the extent of $20,000,000. The Texas fever tick, by discouraging the production of cattle in nearly all of the southern states, has inflicted upon that section a loss that can scarcely be calculated. When we run over the list of lesser pests which exact their toll from our fields, pastures, orchards, gardens, forests and herds, we can hardly consider as excessive the estimate that one tenth of the entire agricultural product of the country, or $300,000,000 per year, is contributed to the support of our small but mighty foes. A few years ago the writer estimated that the average Ohio farm of 88.5 acres suffers an average annual loss of $93.12, the total annual loss for the 276,719 farms of the state being $25,768,073.28, a sum which would support the Ohio Agricultural Experiment Station on the basis of the expenditures for 1904 for 547 years; or by a similar computation it would sustain the Ohio State University, the Ohio State Board of Agriculture and the Ohio

Agricultural Experiment Station combined for sixty-seven years; or it would nearly support the entire educational system of the state for one year.

I have already referred to the relation between the fever tick and Texas fever in cattle in the United States. On the east coast of Africa a similar highly fatal disease, known as African Coast fever or Rhodesian fever, affecting cattle, is carried by a different species of tick. Other tick-borne diseases are heartwater in sheep and cattle; malignant jaundice in dogs, and spirillosis in fowls. Amongst biting insects the Tsetse flies have long been known to slay the horses of African travelers, and we now know that this same genus of flies is responsible for the mysterious and fatal sleeping sickness that has decimated the population in west and central Africa. In Busoga alone 30,000 natives have died in the space of three years from this cause. These flies carry from inoculated to healthy persons certain parasitic protozoans, called trypanosomes, which live in the blood and spinal fluid of man and animals. Recent investigations have shown that crocodiles are intermediate hosts for the protozoans, and if these animals were destroyed it is believed that sleeping sickness would cease. The disease known as anthrax or black-leg in cattle has been communicated to man by bites of horse flies and the common stable fly, and there is little or no doubt that this disease is carried from sick to healthy animals by these insects Circumstantial evidence leaves scarcely a doubt that fleas carry the bubonic plague, not only from person to person, but between rats and men. At the time of a bad outbreak of the plague at Sidney, Australia, it is recorded that rat fleas became so numerous on the wharf at Sidney that the laborers had to tie string around the bottom of their trousers to protect themselves from the vermin. British troops at Hong Kong, only provided with boots, were much bitten by fleas and many contracted plague. The British troops in India, walking in "putties," do not contract it because the fleas cannot get at their ankles. Within recent years mosquitoes have been proved to act as carriers of malaria and yellow fever. By waging war against the various species of Anopheles which act as malaria carriers the number of cases in Ismalia on the Suez Canal, where the number of cases of fever have always been between 1,500 to 2,000 per annum, was reduced in one year to 209. When work was begun on the Panama Canal the region through which it was to be constructed was excessively dangerous to human life, but today the workmen can sit on their outside porches in the evening without being sheltered behind gauze netting, so effectually have the mosquitoes been exterminated. The extent of malarial infection in some regions

may be gathered from such figures as these: In 1900 deaths from fever (unclassified) in India amounted to 4,919,591, most of the cases being in all probability malarial. That is, a population, greater than that of the state of Ohio, was carried off in a single year. The hospital returns from the Indian army report that in this same year the army amounted to 60,653 men, of which 19,445, or nearly one third were so badly incapacitated by malaria that they were obliged to quit duty and receive hospital treatment. The blood parasites or protozoans which cause malaria reproduce in man's blood and fresh generations invade the red corpuscles, causing chills. Anopheline mosquitoes, sucking up the asexual forms of the parasite with the blood, carry these in their stomachs and salivary glands until a sexual generation is produced. The latter form of the parasite is injected into the blood of the next human victim bitten. Yellow fever is carried by the tiger or brindled mosquito, a sprightly, rapid-flying insect, found over the southern states and as far north as Kentucky, also in the West Indies, in South America, in the European countries bordering the Mediterranean and across Asia to China. Wherever the species occurs and a yellow fever patient goes there is always a chance of the dread disease spreading. Ships may convey infected mosquitoes long distances. This species breeds largely in barrels, cisterns, fountains and discarded tin cans in which fruits, vegetables, fish, etc., have been preserved. Anything that holds water is inviting to them. Before the American occupation of Cuba the deaths in Havana varied during the period 1889 to 1900 from 118 to 1,355 per year. In 1901, the first year in which a systematic and wholesale warfare was directed against the mosquitoes, the number of deaths was reduced to five, and in 1902 not a single case occurred. The disease known in tropical regions as elephantiasis or Filariasis is also carried by mosquitoes. This disease is caused by minute parasitic worms, which live in the skin and the lymph. The skin becomes thickened like an elephant's hide, hence the name of the disease. Doctor Graham of Beyrout states that dengue or Dandy Fever is carried by a species of Culex. There is good reason for thinking that fleas transmit leprosy, and bedbugs are practically known, from circumstantial evidence, to have been carriers of this disease in some cases.

Other offices of insects are to destroy noxious plants, to act as pollenizers of plants, to act as scavengers, to work over the soil, bringing the subsoil to the surface and passing the earth through their bodies, thereby enriching it with their intestinal secretions; to furnish human food, to produce materials for clothing, such as silk, and to furnish food for such useful animals as birds and fishes.

The knowledge which we at present possess of the great importance to mankind of the insect world has been almost wholly the accumulation of the past century, for the most part of the past thirty years. Thirty years ago our entomological workers were few in number and their work was but little noticed by the masses, except as an outbreak of the Rocky Mountain grasshopper or some similar phenomenon reminded the thoughtless that creatures possessing neither size nor swagger can sometimes force themselves into the full limelight of human attention. Thirty years ago the United States Department of Agriculture carried an entomological staff that would scarcely compare with the present day staffs of several of our experiment stations, and the experiment stations were not then established. A few state entomologists kept lonely vigils in cramped quarters, and maintained their enthusiasm by corresponding with each other and from pure love of the work. At present the Government Bureau of Entomology employs more than 100 scientific investigators and 250 clerical employees. Fifty-one experiment stations scattered through our states, territories and island possessions employ in the aggregate from eighty to ninety entomological workers, besides clerical help, and have considerable equipment in the way of libraries, machinery, etc. The regular appropriation made by the last Congress for the Bureau of Entomology was $184,960, besides an emergency appropriation of $250,000 to be expended under the bureau's direction for suppression of the gypsy moth. The appropriations made by the various state legislatures in support of entomological investigation by state agencies is much more liberal than formerly, New Jersey in some years giving as much as $10,000 for mosquito extermination work alone, and Massachusetts $250,000 to be expended against the gypsy moth.

Following the lead of the United States in this study of insect control, many other countries, in every quarter of the globe and the islands of the sea, have employed entomologists, taking from America as many experienced men as could be persuaded to go at salaries from double to quadruple what they receive at home.

This small but trained army of workers is busy following out the life histories of insects which are injurious, testing the effects of various poisons and insecticides upon both insects and plants, with the aid of mechanics devising machinery suited to insect warfare in garden, field, orchard, forest and city, noting the effects upon insects of meteorological and climatic conditions and changes, and studying the interrelations existing between different species of insects, and between insects, birds and insectivorous animals. Many of our worst insect pests are importations from foreign lands, such as San José scale,

Hessian fly, gypsy moth, brown-tail moth, cotton boll weevil and codling or apple worm. When first introduced these pests, being unmolested and not kept subdued by their natural enemies, which were left behind, often multiply prodigiously and make for themselves unheard of records for destructiveness. In such cases nature's balance is not restored until their old enemies are imported to prey upon them, or until parasitic and predaceous forms, native to their new home, acquire a taste for them. A striking illustration of the benefits which may sometimes be obtained by fighting insects with insects was given by the importation of the Australian lady-bird into California. The cottony cushion scale, a citrus pest, was introduced into California from Australia about 1868. By 1886 it had spread to eight different countries, and three years later so much of the orange territory had become infested and so helpless were our entomologists and the citrus producers before its rapid march that the entire citrus industry in the state seemed doomed, and many of the growers had already abandoned or were preparing to abandon their business when the advent of the lady-bird happily restored confidence and the fluted scale has not been a very important factor in California orange culture since. Something like 127 lady-beetles were received from Australia and, from the progeny of these bugs alone, California was completely stocked and practically cleared of the scale in about eighteen months. A few years since, while entomologist of the Florida Experiment Station, the writer had the pleasure of repeating this California exploit in the Florida orange groves, where the same scale had become accidentally established. Another parasite brought over from Australia at the same time as the lady-bird has cleared many of the olive groves of California of the black scale and has been a great factor in preventing headway by this pest. At present the United States Bureau of Entomology, in conjunction with the Massachusetts authorities, is making importations of parasites and predaceous insects for trial against the gypsy and brown-tail moths on the largest scale that has ever been undertaken. Hundreds of thousands of host insects, containing parasites, have been brought each year from a large part of their geographic range. More than forty species of parasites have thus been brought over, bred and liberated. Several of them have certainly established themselves in New England and there seems to be every reason to believe that speedy success will be reached. As a summary of the general teaching of the paper, I cannot do better than close with the following quotation from the acute writings of our government's entomological chief, Dr. L. O. Howard:

"Man is but one of the forms of life struggling for existence, at con-

tinual warfare with surrounding forms, but by virtue of his surpassing intelligence—itself as gradually evolved as have been the physical characteristics of any given species—he has overrun the earth, has accommodated himself to the most unnatural environments; he has dominated all other species in nature; he has turned to his own uses and encouraged or hastened the evolution of species useful to him or of useful qualities in such species; he has wiped out of existence certain inimical forms, and is gaining the control of others. He is the dominant type, and types whose existence and methods of life are opposed to his interests are being pushed to the wall. It is the culmination of a history which has many times repeated itself in past ages. The struggle of other forms of life to accommodate themselves to the conditions brought about by the rapid development of the dominant type is one of the most interesting fields of study open to the biologist today. It would seem as if, in man's efforts to make the face of the earth his own, all the complicated elements of life were arrayed against him, and the great and ultimate result of the labor of the biologist in his study of the relations of the different forms of life and the laws which govern their development will be to bring about the absolute control of all other life by man. Thus it is not only the economic worker who looks for immediate results of a practical kind from his labor—the scientific agriculturist, the horticulturist, the economic zoologist, the medical bacteriologist—who should command the respect of even the practical minded man, but the biologist in whatever field, however restricted it may be, whether he is working towards the understanding of broad principles and general laws or whether in some narrow corner of research he is accumulating material which will help ultimately to lead to wider understandings—all are working helpfully and practically towards the perfect well being of the human race."

MEASURES SUGGESTED AGAINST THE ARGENTINE ANT AS A HOUSEHOLD PEST

By WILMON NEWELL, *Baton Rouge, La.*

The preliminary investigation of an injurious insect usually suggests measures by which temporary relief from its ravages may be secured, even though many years of tedious work and study may be required for the development of really satisfactory and economical methods of control. To this rule the Argentine ant, *Iridomyrmex humilis* Mayr., has proven no exception. Our study of this species

has not proceeded far enough so that we can claim to have "found a remedy," as our correspondents would say, but in the course of two years of observation certain simple measures for protecting residences and food stuffs from the annoying inroads of the pest have presented themselves.

As one of the writer's assistants, Mr. T. C. Barber, has recently found infestation by this ant exceedingly heavy at Delta, La., a point on the Mississippi River opposite Vicksburg, Miss., with an elevation of 87 feet and 325 miles above the mouth of the Mississippi, there seems no longer any reason for not considering all of the Gulf States subject to future infestation by this pest. The problem is therefore one in which all southern entomologists are interested, and its novelty is likely to appeal to those entomologists whose sphere of activity is at present outside the territory likely to be invaded.

It is for relief from the Argentine ant as a household nuisance that most requests are made by correspondents. There is therefore ample excuse for presenting to the economic entomologists at this time a brief account of those measures which have been found to possess more or less utility in dealing with this pest.

Sufficient has already been published regarding the habits of this ant[1] to make any detailed reference to them unnecessary in the present paper.

Direct Methods of Destruction

Permanent relief from the inroads of this species can come only through actual destruction of the ants themselves. The use of nothing but repellents serves only to postpone the adoption of laborious methods of warfare and to permit the continued increase of the species. Not only is it necessary to kill the ants outright, but it is also necessary to adopt means which will destroy the queens. It is hardly necessary to call attention to the marked difference between killing ants and killing the usual insects with which we have to contend. If one kills a female gypsy moth or boll weevil, for example, possible future progeny of the individual insect is made impossible. Not so when the worker ants are destroyed, for the rate of increase and the development of future generations are in no way interfered with. This is true for the simple reason that workers do not reproduce, the eggs being deposited exclusively by the queens. Our observations indicate that one per cent, or less, of the workers in a colony can keep the remaining individuals fully supplied with food. Were one to destroy, by means of sprays or poisons, all foraging workers leaving a colony

[1] Journal of Economic Entomology: Vol. I, p. 21-34; Vol. II, p. 174-192.

during twenty-four hours, the colony would be no weaker at the end of the period than at the beginning, for the workers destroyed would be equaled or exceeded in number by the workers reaching maturity during the same period within the colony. The futility of methods which do not destroy the colonies, and particularly the queens, is therefore self-evident.

Winter Trapping

Reference was made in a preceding article[2] to the tendency shown by the Argentine ant colonies to segregate or combine in the autumn, preparatory to passing the winter as large colonies, containing thousands of workers and larvæ and dozens, or even hundreds, of queens. These large colonies seek their domicile in well-protected locations favorable for passing the winter. Warm situations are particularly attractive to them. This habit we utilize in the following manner: About the first of October an ordinary dry goods box, about 2x2x3 feet, is filled with cotton seed and straw, or other porous vegetable material, and placed near the center of the ordinary city lot or garden. The top of the box is left exposed to the weather so that the contents will become moist and commence to decay. As decay proceeds the center of the mass becomes very warm and the whole presents a nesting situation so attractive to the ants that practically all colonies within a radius of thirty or forty yards take up their abode in it as cool weather approaches. On warm days the ants will be found near the outside of the mass and on cold days nearer the center, as they move inward towards the warmest part until the desired temperature is reached. During January the cracks in the box are closed tightly, the top covered with a waterproof canvas and a pound or two of carbon bisulphide poured into the box to destroy the colony.

A box of this kind, shown in the accompanying illustration, was prepared in the fall of 1907, not for the special purpose of destroying ants, but for making a small amount of compost for a garden bed. The ants moved into it in such large numbers that the opportunity for destroying them at once presented itself. During the winter this immense colony was examined from time to time and upwards of 150 fertile queens taken from it, together with eggs, larvæ and pupæ by the cupful as wanted. A conservative estimate placed the number of fertile queens in the colony at upwards of 1,000. The colony in question was not destroyed, as the writer kept it under observation to see "what would happen." He found out. Early in March, 1908, the ants migrated from the box in small colonies and established themselves over the entire premises, with the result that the place was

[2] Journal of Economic Entomology, II, p. 191.

The unbidden guests.—Argentine ants on a lunch table.

heavily overrun with them and they proved themselves intolerable nuisances during the ensuing summer.

The experiment was repeated on the same premises (a city lot about 40 by 100 feet) in the fall of 1908, but the colony was destroyed with bisulphide during February, 1909. The difference in the infestation of the premises this season, as compared to last, is remarkable.

Fig. 5.—"Winter trap" for the destruction of Argentine ant colonies. The heat of the decaying vegetation attracts the colonies to the box, where they are destroyed by fumigation with bisulphide of carbon.

Up to the present writing (July 25th) their presence has hardly been noticed, many days elapsing at a time without a single ant being seen inside the residence. At the present time, however, the place is again being occupied by colonies working their way into the premises from adjoining lots, where no steps were taken for their destruction.

So effective has this winter trapping appeared to be that we fully believe that if it were carried out uniformly, by the residents of several or more contiguous city blocks acting in coöperation, few if any other measures would be necessary to hold the pest in reasonable check.

Destruction of Colonies in Summer

Much can be accomplished by destruction of colonies during the summer months, but owing to the relatively small size of the colonies and their occurrence in every conceivable situation,[3] steady and per-

[3]Following are some of the situations in which colonies of the Argentine ants

sistent effort is necessary to bring about anything like satisfactory control.

Colonies located in the ground can be destroyed by the well known method of pouring bisulphide of carbon into the nest through an opening made with a sharp stick and then covering the nest well with moist earth.

We have tested the solution of potassium cyanide, one ounce to the gallon of water, used by Mr. R. S. Woglum of the Bureau of Entomology, for destroying other species of ants in California, but have not been satisfied with the results. In one experiment a fairly heavy spraying of the ground with the cyanide solution failed to kill larvæ and mature forms one half inch below the surface. As the underground chambers not infrequently extend to a depth of 12 or 14 inches, an immense amount of this solution would be necessary for effective work.

Crude oil as it comes from the oil wells, usually known in the South as "Beaumont oil," is a valuable auxiliary in the fight against the ants. It is certain death to any insect it touches, but being also fatal to vegetation, its use is principally restricted to the destruction of colonies which are exposed by the overturning of boards, boxes, piles of rubbish, leaves, etc. Colonies of the ant are exposed when least expected and in unthought of places. One must therefore keep the oil handy, ready for immediate application to the nests whenever they are found. We have found the small compressed-air sprayers, which are readily carried about and which are always ready, very convenient for use in destroying these summer colonies. Crude oil, poured liberally upon the ground where a colony has its underground abode, will gradually work its way through the galleries and either destroy the entire colony or destroy the major portion of it while the balance betakes itself to a less objectionable location.

In lieu of the crude oil, hot water, kerosene, Kreso, Zenoleum, creosote or other powerful liquid insecticides may be used for destruction

have been found: In the earth, under boards, beneath shingles on roofs, in rolls of wrapping paper, under rugs, in foundations, between walls of dwellings, in attics, under bark of trees, in manure piles and compost heaps, in tall grass, in bean bushes, in bags of sugar, in the tops of trees, in flower pots, in the veneer covering of metal cans, in garbage cans, in piles of brick and stove wood, between doors and their thresholds, in bee hives with colonies of bees, under discarded roofing tin, in various places on steamboats, around the roots of cotton and other growing crops, in the cinder ballast of railroad tracks, in decaying logs, under brick and concrete pavements, within porch pillars of wood, in hard clay roadways, in old clothes, under street car tracks, in greenhouse benches, inside the husks of roasting ears and in old birds' nests.

of the colonies that may be exposed, but all of them are more expensive than the crude oil.

Colonies which are located in inaccessible situations can, by patient work, be coaxed into domiciles where they may be destroyed. Decaying wood is *par excellence* the favorite nesting place of the species. Coupled with this is the habit repeatedly shown of colonies moving into close proximity to any constant source of food. Many colonies are therefore effectively destroyed by placing pieces of decaying logs here and there in shaded locations and placing beside each one a small jar of honey or sugar, its top covered with wire cloth to prevent the contents being removed by bees and other large insects. This attractive nesting place is shortly occupied by a colony of the ants and the latter is then destroyed *in toto* by submerging the entire block of wood in a pail or tub of boiling hot water, after which it is "reset" to attract another colony.

These measures, involving as they do considerable labor and time, are not likely to be applicable in orchards or over large cultivated areas, but on the small city lot where protection from the ants must be secured or the premises vacated, they are far better than no methods at all.

Poisoning the Ants

As pointed out above, the use of poisons cannot afford satisfactory relief unless the poison used is one which will destroy larvæ and workers, as well as queens, within the colony. To meet this requirement the poison must be fatal but must act so slowly when contained within the insect stomach that it will not kill the foraging workers ere they can transport it to the nest and there deliver it to other members of the colony. Our efforts to secure a poison meeting this requirement have met with only indifferent success, the following possessing some little merit in this direction: One part, by measure, of paste lead arsenate is thoroughly ground with pestle and mortar with twice its bulk of pulverized sugar. This forms a liquid which in turn is mixed with an equal bulk of honey and the whole mass thoroughly ground and mixed. Another mixture, nearly as good, is made by thoroughly mixing one part of *powdered* arsenate of lead with five or six parts of honey. This is placed in small dishes where the workers can help themselves and when, after a few days, they cease to work on it, it is removed to a new location. When poison of this character is moved even a few inches, the ants seem not to recognize it as dangerous and attack it with renewed energy. In an experiment with the mixture of honey and powdered arsenate of lead a colony was permitted to choose as it pleased from the poisonous mixture and from non-poisoned

honey and other food, with the result that the mortality within the colony slightly exceeded the rate of reproduction and the entire colony became extinct in forty-four days after the beginning of the experiment.

When not supplemented by other measures, such as mechanical destruction of the colonies, the use of these mixtures will not be found satisfactory unless used steadily and persistently for a long period.

Sweetened preparations of soluble arsenic are of little direct use as they kill the majority of the foraging workers taking them and little, if any, of the poison reaches the colony proper. Such preparations are, however, useful in driving the ants away from limited areas within buildings, as described below.

Repellents

Various schemes and substances have been tested for the purpose of keeping the ants off tables, away from food stuffs and out of buildings and rooms, but the only ones worthy of mention are the corrosive sublimate "ant tape" and the sweetened solutions of white arsenic.

Ant Tape

Ants of this (and of some other) species will not cross cotton cloth or tape which has been thoroughly soaked in a saturated water solution of corrosive sublimate and then dried. In practice the tape is tacked around table legs, around edges of shelves, etc., to protect sugar, candy, meat, syrup, and similar materials. Our method of preparation is to first prepare a solution of the corrosive sublimate by heating the sublimate and water in a *porcelain or granite ware* vessel until the maximum amount is dissolved. This solution is allowed to cool to ordinary temperatures, then filtered, and ordinary cotton or binding tape soaked in the filtrate for several hours. The tape is removed and pinned up on a wall to dry, after which it is ready for use. It is very important that no iron, tin or steel come in contact with the solution or with the tape itself after being made. In actual test we have found the tape thus prepared to successfully repel the ants for eleven months without being renewed.

For several years "ant tapes" and "ant papers" of this character have been on sale in New Orleans and other southern cities in the infested region. The ant paper is usually prepared by painting a sheet of paper with corrosive sublimate solution or some mixture containing it. Most of the commercial ant tapes and papers are carelessly made and hence are often found next to useless or are effective for but a short time.

The use of corrosive sublimate for this purpose seems to be mentioned rarely in entomological writings, but there is ample evidence that it has been used in this manner for at least two generations. Prof. C. W. Hutson, formerly professor of history in the Agricultural and Mechanical College of Texas, informs the writer that his father, Wm. F. Hutson, who resided in the vicinity of Beaufort, S. C., was accustomed to soak cotton strings in corrosive sublimate and use them to protect barrels and other places containing sugar from the native ants as long ago as 1850. Professor Hutson does not know whether this knowledge originated with his father or whether it had been handed down from preceding generations, but the instance is interesting in showing how knowledge of much practical value may escape "official" notice indefinitely.

Sweetened Arsenical Solutions

Our experiments have shown that solutions of sugar or molasses containing a small percentage of arsenic can be used to "drive" the ants from a room which the foragers persist in visiting. The best solution of this kind is made as follows: White arsenic, ½ gram; cane sugar, 20 grams; water, 100 cc.

The arsenic is dissolved in a portion of the water by boiling and the sugar dissolved in the remaining portion. The two solutions are then mixed and sufficient water added to compensate for the evaporation. Fruit juice or other inert coloring matter may be added to give warning of its dangerous nature. Placed in small dishes beneath cupboards, refrigerators,[4] etc., the workers attack it vigorously for a few hours, then in decreasing numbers, and after three or four days forsake its vicinity entirely. By placing a small dish of this poisonous mixture beside a jar of honey, without other protection, we have forced the ants to entirely abandon the honey after having worked vigorously on it for several days.

Prof. C. P. Lounsbury, Entomologist of the Department of Agriculture at Cape Town, South Africa, writes us that considerable success has been attained in repelling the Argentine ants from residences there by the use of very similar mixtures. Those most frequently used by Professor Lounsbury are Cooper's Dip and Golden Syrup, equal parts, and a mixture of marmalade, sugar and arsenite of soda.

Various compounds of sugar and arsenic under such suggestive names as "Thunderboldt," "Great American Ant Poison," etc., are

[4] The temperature of the average refrigerator is not low enough to discourage the ants in the least. Fresh meat, lard, fruits, etc., are as subject to attack as if they were in a temperature of from 70 to 80 degrees.

on sale in the ant infested region, and while extravagant claims are made for them by their manufacturers, they are of little value aside from use as repellents, in which classification they should properly be placed. The prices charged for such poisons are usually out of all proportion to their real value.

Owing to the dangerous nature of the ant tapes and arsenical poisons, it is our custom to advise correspondents that these be prepared by pharmacists rather than by the inexperienced and labelled with the proper precautions and directions for use.

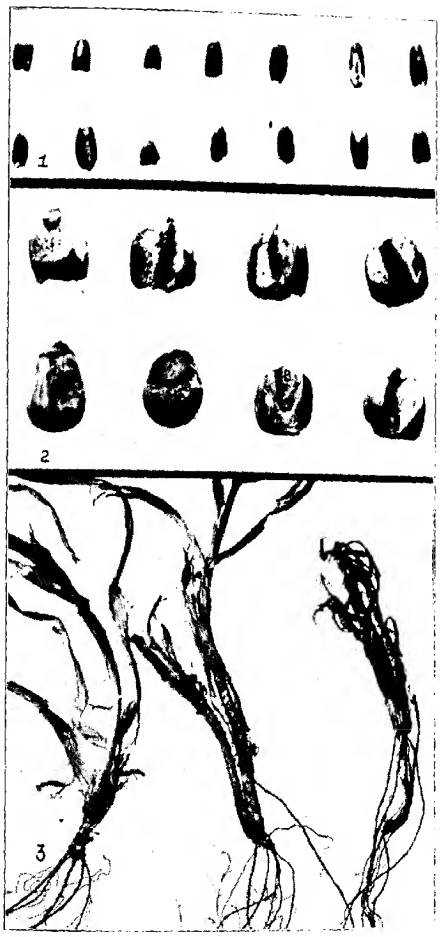
Baton Rouge, La., July 25, 1909.

ELEODES AS AN ENEMY OF PLANTED GRAIN

By MYRON H. SWENK, *Assistant State Entomologist, Lincoln, Neb.*

Within the past year a new insect enemy of planted grain has come to our notice in the form of a tenebrionid beetle larva, which destroys the seed in the ground before it can germinate. The work with this insect having been continued for less than a year, the results are as yet necessarily somewhat fragmentary, but similar depredations by allied species on the Pacific coast, which I am informed by Professor F. M. Webster are now demanding his attention, seem to make desirable a preliminary report at this time. Our attention was first drawn to this new pest by a letter received under date of September 22, 1908, from a correspondent at Beaver City in Furnas County, Nebraska, complaining of numbers of these larvæ in the soil which were destroying the planted wheat in that vicinity, and a specimen of the larva concerned accompanied the letter. A request to our correspondent for more specific and detailed information elicited the reply that the larvæ were abundant in the wheat fields north of the town, three or four of them to the foot in the drill rows, and in two fields he knew of were doing a great deal of damage, so much so that it would be impossible to obtain a stand of wheat. The situation was apparently serious enough to warrant personal investigation, and accordingly on the 29th of September the writer visited the locality to look over the infested fields.

The first field visited was one located three miles north of town, where the larvæ had been originally discovered and reported upon. This field had been in corn the previous year. The larvæ were found abundantly in every part of the field, and about 60 per cent. of the planted seed, judging from several hundred kernels collected in the



INJURY TO WHEAT AND CORN BY ELEODES OPACA.

1, seed wheat taken from drill rows showing type and extent of injury to the planted kernels; 2, similar injury to corn when placed in rearing cages; 3, injury to bases of growing wheat plants. All slightly enlarged (originals).

drill rows, had been badly gnawed so that they could never germinate. Many kernels were almost entirely eaten up, as the accompanying illustration shows. As our correspondent had written, four or five of these larvæ were to be found in every foot of the drill row, and in a half hour over forty of them were picked up. Another field planted in ground just broken from sod was almost as severely infested. In still another field growing up to volunteer wheat the larvæ were present abundantly. In fact this condition seemed to be general in all the fields over the whole region, extending at least over the southern half of Furnas County, as over a dozen farmers of the vicinity with whom the writer spoke testified that their fields were infested similarly to those examined. It was necessary with one field of ninety acres in winter wheat to completely resow forty acres. At the prevailing price of wheat this was so serious an item that some of the oldest wheat growers would not replant, but decided to allow the ground to lay over until they could plant corn in the spring.

While searching for larvæ in the drill rows a solitary specimen of *Elcodes opaca* Say was caught as it crawled sluggishly over the ground. The owner of the field immediately identified this beetle as the same as certain "black bugs" concerning which he had just been inquiring, great numbers of which had swarmed in the fields just after harvest (late July), and other farmers corroborated this testimony from experience in their own fields. In fact we had received reports of this occurrence, accompanied by specimens from McCook, in the same general region, at the time. So abundant were the beetles on this farm that the owner became alarmed and tried poisoning them, but with what success he did not fully ascertain. On hot days up to the latter part of October the beetles were still in evidence.

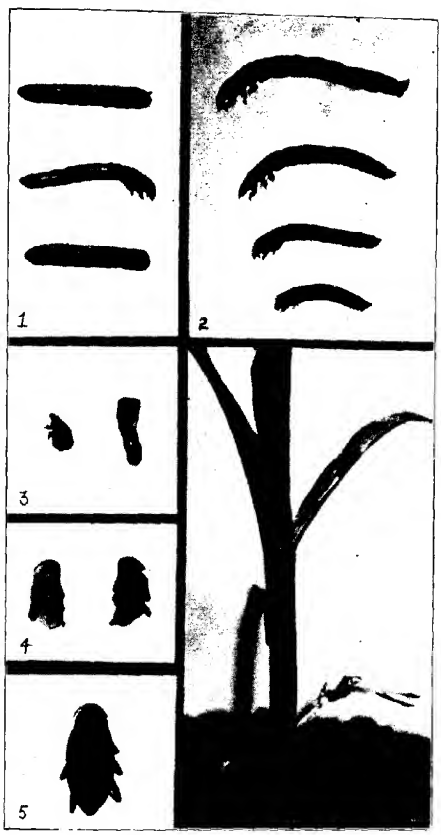
After a careful examination the larvæ were identified as apparently belonging to one of our tenebrionid beetles, probably an *Elcodes*, and specimens were sent to Prof. F. M. Webster, who corroborated this determination. The abundance of the beetles of *Elcodes opaca* in the fields during the summer and the great abundance of these certainly allied larvæ in the same fields later in the year justified our tentative reference of the new pest to that species, which identification has been amply verified by subsequent rearings of the larvæ.

Following my visit to Beaver City there was a heavy rain in the vicinity, and immediately after this rain the larvæ were found "crawling all over the top of the ground by the thousand," according to our correspondent, who had agreed to keep the larvæ under observation for us, but they returned to a slight depth after the ground had dried out somewhat. Following this rain the injuries distinctly

abated, the larvæ seemingly not injuring the germinated wheat or sprouts. Though no corn fields were examined by the writen while at Beaver City, farmers stated that some of these larvæ were present there also, even in one field which had not been cropped in wheat for five years. Furthermore, in our breeding cages the larvæ ate corn kernels greedily, while two of them were taken from a box containing several ears of corn shipped in from Gothenburg, Nebraska, as samples of corn-ear worm injury. Presumably they had located themselves in the tips of the fallen ears and in transit had made their way out again. Accordingly it will not be surprising if this insect is found to be at times of serious injury to planted corn also.

On April 14, 1909, Mr. C. H. Gable of this office visited the same locality and found that the stand was so thin that most of the fields were being disked preparatory to planting a new crop. The larvæ were not in the drill rows, as a most careful examination disclosed, but were abundant just underneath the surface in the little piles of loose, dry drifted soil, in old corn fields about the half rotted stubs, sometimes as many as thirty about a single stub. They were also feeding upon the crowns of the wheat plants to a small extent, especially where these were adjacent to the drifts wherein the larvæ were congregated. Mr. Gable found larvæ actually engaged in this injury, the exact character and extent of which is shown in the accompanying illustration. It is possible that these larvæ do not descend to a great depth in the winter and that they have considerable resistance to cold is shown by an accident which befell one of our breeding cages. On the night of January 28 a storm blew in one of the windows and dashed the cage to the floor, spilling the contents. This happened at about 10 p. m. and for twelve hours they were exposed to a sweeping wind of from fifty-nine to seventy-two miles an hour at a temperature hovering about zero. The next morning they were gathered up and placed in a warm room and out of eleven thus gathered eight recovered activity and burrowed under the ground again.

In our breeding cages the first pupa was found on the morning of May 28, when a larva which had come to the surface and lay there quietly for three days pupated over night. Twelve days later, June 8, this pupa had developed into a beetle. Another larva, which came to the surface of the ground May 28, had pupated May 31 and transformed to the imago June 10. Other larvæ pupated down to several inches in the earth, the last pupa being secured July 19. Almost simultaneously with the emergence of the beetles in the breeding cages they began appearing in numbers in the fields, and under date of June 17 our correspondent at Beaver City reported large numbers of them



STAGES OF ELEODES OPACA.

1, full grown larva of *Eleodes opaca*, dorsal, lateral and ventral aspects; 2, larvæ of *E. opaca* (lower figures) contrasted with a larger apparently distinct species found in similar situations (two upper figures); 3, shed larval skins of *E. opaca*; 4, pupa of same; 5, imago (♀) of same; 6, beetle on young corn plant. All about natural size except 6 which is reduced one-half (original).

crawling about over the ground. During the present summer (1909) they have been as abundant as last year, and under date of July 31 our correspondent reports them in undiminished numbers but tending to burrow out of sight in the ground, probably for purposes of oviposition. A female was dissected on August 10, the ovaries of which contained seven eggs. These eggs were oval, the chorion pure creamy white and without sculpture and measured 1.5–1.7 mm. x .8 to .85 mm. Other gravid females placed in a breeding cage with the bottom shallowly covered with earth on August 9 soon deposited eggs in the soil and when this soil was re-examined August 30 newly hatched living larvæ as well as larger dead and dried larvæ, evidently hatched several days previously, were found, apparently fixing the hatching period at something less than three weeks. The newly hatched larva is soft, pure white in color and about 2.5 mm. long, but soon darkens and assumes its corneous integument.

The fully grown larvæ of *Eleodes opaca* average about 16 mm. long, are yellowish in color and have a very striking general resemblance to wireworms because of their heavily chitinized elongate, cylindrical and ventrally flattened bodies. The body surface is glabrous, except on the ventral surface of the head and thorax, on the legs and on the pygidium. The larva agrees very closely with Blaisdell's figures and description of the larva of *Eleodes dentipes*[1] but has several minor points of distinction, *e. g.*, the anterior legs are quite spineless, but the intermediate and posterior legs are abundantly spinose, the pygidium is subtriangular, with apex broadly rounded and bearing two small spines, while on each lateral margin may be found six or seven minute blunt tubercles, the whole of the segment bearing scattered long bristles. The pupa is 16 mm. long x 3.5 mm. wide, creamy white, darker on the head and legs, with the antennæ blackish, and in general structure agrees quite well with Blaisdell's figures and description of the pupa of *Eleodes clavicornis*, but the third and fourth ventral segments are transverse apically like the others, the small segment at base of terminal cerci is but feebly emarginate, the emargination of the lateral processes of segments 2–6 are of a radically different and more complex pattern, while the pronotum has but a single row of closely set lateral setæ, the post-apical and antebasal being very feeble or lacking, etc. The image is well known and has been quite adequately described elsewhere.

The success of our breeding experiments was greatly detracted by the presence among the larvæ of what was apparently a bacterial disease. A small dark red spot would appear somewhere upon the

[1] Blaisdell, Revision of the Eleodiini of the United States, p. 497–499 (1909).

body sutures, usually back of the head or on the terminal abdominal segments, which in a few days would extend nearly completely around the body and within a short time after this the larva would be dead. Three different lots of larvæ, secured at various times and placed in different cages all finally succumbed to this disease. The living larvæ took advantage of the presence of the dead ones by eating them, and several specimens were taken from the cages in a partially devoured condition. The larvæ shun light and if taken out and released dig back into the earth with great rapidity. When first disturbed they almost invariably feign death and after lying motionless for a time suddenly dig into the earth or run away with frantic energy. The pupæ are very sensitive and wriggle and twist vigorously if disturbed in any way. The beetles fed voraciously upon corn leaves in our breeding cages, gnawing large longitudinal holes in them in a short time.

While *Eleodes opaca* is undoubtedly the species responsible for most of the injury to planted grain in this state, frequently a larva apparently belonging to one of our several other species is found in the same situations as *opaca*. In Nebraska we have *E. tricostata* Say, *E. obscura* Say, *E. suturalis* Say, *E. pimeliodes* Mann., and *E. hispilabris* Say extending over practically the entire state, *E. opaca* Say, *E. obsoleta* Say and *E. extricata* Say occurring in the central and western portions, and *E. nigrina* Lec. occurring in the extreme northwestern part of the state, and some of these species undoubtedly occasionally attack planted grain. Other related genera may also take some part, as specimens of *Embaphion muricatum* Say occurred this year in company with the swarms of *Eleodes opaca* in the infested fields.

DEMONSTRATION WORK IN ECONOMIC ENTOMOLOGY

By Franklin Sherman, Jr., *Entomologist, State Dept. of Agriculture, Raleigh, N. C.*

Probably every entomologist feels that the importance of his work is not properly appreciated by his public. We find that the public does not understand an entomological emergency when it exists,—that it does not always take us at our word when we say that certain treatments are effective, practical and necessary,—or if the public listens to our recommendations at all it is only with indifference, to go its way in the old lines.

To be sure there is in every state a progressive element (larger in some states than in others, but always in the *minority*) that keeps

breast of modern discovery and practice,—but is this element really the one most important to reach? It is able to take care of itself and is in the minority. It is doubtful therefore whether work conducted especially for this more intelligent and progressive element really results in that "greatest good to the greatest number," which is often accepted as a test of real utility. We take it that with many of us the question of reaching the great mass of our constituents *effectively*, to show them that economic entomology really has something of value to offer them, is a matter to which we could profitably give attention, and upon which we would be justified in making considerable expenditures.

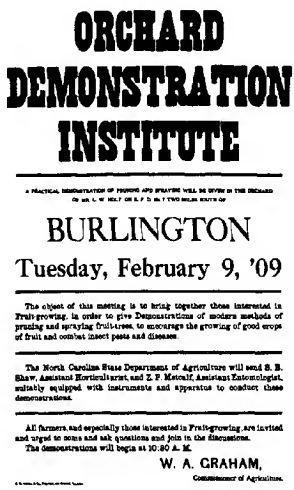
And let us state emphatically that we would not advocate popular demonstration work to the exclusion of investigation, not at all. Some of us are so favored with appropriations that we can carry on both lines at once. Those of us who, like myself, are not so fortunate might plan to set aside a few weeks of each year for work of this sort. We are doing this in North Carolina and it is working well.

On assuming the duties here some years ago the writer found that very few fruit-growers were spraying their trees, even when known to be infested with the San José scale, and spraying to control codling moth was almost unknown. These men knew no such science as entomology and acknowledged no indebtedness to its teachings. We soon found that the bulletins circulated but little among our orchardists and that the *average* man gives but little attention to such bulletins as he receives.

We have taken up the spraying of apple trees with poisoned Bordeaux as the line of work in which we could most certainly assure our people of profitable returns for their labor,—also for the reason that its results show up strikingly and convincingly, and is therefore a sort of advertisement of itself.

During 1908 we conducted apple-spraying demonstrations in five different counties in the apple-growing section, one in each county. The demonstrations were widely advertised in advance. The party carried a bucket outfit, as used in small orchards, and a complete barrel outfit with two leads of hose, extension rods, double nozzles, etc., such as is the standard for small commercial orchards. Three or four trees only were treated at each place, and one of these was sprayed on only one side. The poisoned Bordeaux was made up in the presence of the audience and then sprayed on the trees, every step being explained. We used Paris Green as the poison for the reason that it is more available to the average man than arsenate of lead. This series of public demonstrations was given during February before the buds began to

open, and at each place we explained that two more treatments with the same material would be given to the same trees. The second treatments were given just after the blossoms fell,—April 16th to 22d in this case—and the third treatment was given from two to three weeks later.


ORCHARD
DEMONSTRATION
INSTITUTE

A PRACTICAL DEMONSTRATION OF PRUNING AND SPRAYING WILL BE GIVEN IN THE ORCHARD OF MR. L. W. HOLT ON R. F. D. NO. 7 TWO MILES SOUTH OF

BURLINGTON

Tuesday, February 9, '09

The object of this meeting is to bring together those interested in Fruit-growing, in order to give Demonstrations of modern methods of pruning and spraying fruit-trees, to encourage the growing of good crops of fruit and combat insect pests and diseases.

The North Carolina State Department of Agriculture will send S. B. Shaw, Assistant Horticulturist, and T. F. Metcalf, Assistant Entomologist, suitably equipped with instruments and apparatus to conduct these demonstrations.

All farmers and especially those interested in Fruit-growing are invited and urged to come and ask questions and join in the discussions.
The demonstrations will begin at 10:30 A. M.

W. A. GRAHAM,
Commissioner of Agriculture.

Fig. 6.—Copy (reduced) of poster used in advertising spraying demonstrations in North Carolina (1909).

We felt that we had carried our work to the very doors of the growers. and yet the attendance and interest was in some cases very disappointing. More than once we went to work at the appointed hour with only two or three spectators. In one or two cases even the owners whose trees were treated seemed rather indifferent when the work began. In two or three places the attendance was satisfactory. The critical and the faint-hearted could have easily declared the demonstration work a failure and with good show of reason.

But by midsummer the treatments began to tell. We requested reports from all five growers in mid-July, and *every one* reported a distinct advantage in favor of the sprayed trees. (Of course this is nothing new to the readers of this JOURNAL, but it *meant something* to these men!) Even the sprayed half tree showed its superiority in every case over the unsprayed half of the same tree. A second report was requested in October and again in *every case* the grower reported that the prospects of mid-summer were more than justified. that

foliage was healthier, the fruit better, and in better condition for winter keeping, and several of these men who had never seen a sprayed tree before in their lives concluded their reports like this, which is quoted verbatim: "I will buy a large spraying outfit and will spray all my trees next season."

But still only a *few* had been reached. It remained to write up a brief readable account of the work, including the favorable reports of the growers, and to send it *to the people who ought to be interested*. For several years we have kept up an inquiry into orchard conditions by means of circular letter and blanks, and now have a list of about 1,500 names, representing about 500,000 apple trees in commercial orchards. This then is a *live list of real fruit-growers*. This little ten-page circular on "Apple Spraying Demonstrations, 1908" (Circular No. 24 of this office) was sent to this list, and we venture the guess that few, if any, of the copies were thrown away, at least until they had been read from beginning to end. Here are a few quotations from that circular:

> "Spraying must come to be the *regular* practice of the *majority* of our growers and not practised regularly by an insignificant number and trifled with spasmodically by a few more. . . . Just as soon as our growers learn this lesson and make it a vital part of their practice they will find fruit-growing profitable, but not before. For your own sakes *study* this spraying business and *get to work at it*. . . . It is likely that similar demonstrations will be given in 1909. . . . We hope that the interested fruit-growers will *be there*, and then go home and *practise* what they learn."

The spraying demonstrations for 1909 are now completed and we await the harvest with confidence. We enlarged this season to twelve demonstrations, each in a different county and all in counties not touched last year.

And now, after the final results of last year have been published and distributed (*among those interested*), we are getting the *real* results that we have been after. We are reaching, and reaching effectively, the actual *majority* of the fruit-growers in the neighborhoods where the demonstrations are given. They are *all* becoming acquainted with spraying methods, and *many* of them have already bought outfits and applied to us for directions for the work. A few incidents will be of interest. Soon after our demonstration at Burlington a man (not a commercial fruit-grower) who attended was in my office and said he felt that he personally profited not less than $10 by what he learned.

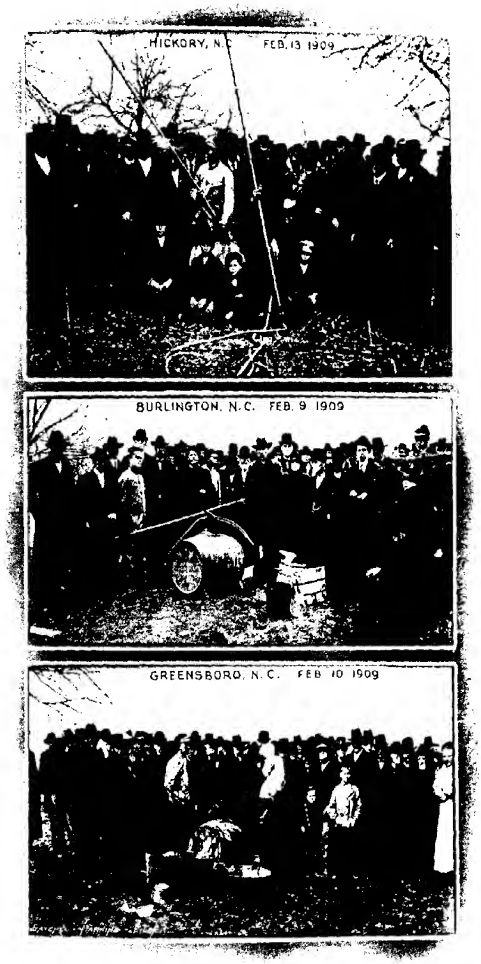
and he went about twenty miles to attend the meeting. At Greensboro there was an attendance of nearly one hundred men, *there for business,* and in less than a week afterward every hardware firm in the town had sold every spray-pump in stock and many more good outfits were ordered from the makers. At Mocksville there was one man who came nearly forty miles by rail for the one purpose of attending the meeting. Concerning that same meeting Mr. J. D. Hodges, in whose orchard the work was done and who is also county superintendent of schools, wrote:

> "The work was carefully and painstakingly done. At each step explanations clear and plain, in language easily understood by the plainest and most unlearned citizen, were made. In my work as superintendent of schools I have been in all parts of the county since, and everywhere people inquired about the work. The money spent by the state in these demonstrations is well worth while,—is indeed bread cast upon the waters that will return a hundred-fold enlarged."

At the demonstrations at Shelby there was a man in attendance who *walked* twenty miles for that one purpose, and at several meetings there were persons who had driven an equal or greater distance. And never before have we had such a deluge of inquiries from persons who want to begin spraying as we have had this spring.

The reader may think that we are overdoing the matter, that we are lessening the dignity of the profession by a cheap appeal to the public, but we have had that point constantly in view all the time and plead "not guilty." We have at times been accused of being too mild in our claims for spraying, and have been told that we should make our statements more positive and less conditional. Every detail of the work is thought out and provided for in advance, and we keep on the safe side of conservatism in our statements to the growers,—that is why we are getting their confidence in this matter, *because what we advise we have proven to them.* This is not cheapening our work, it is making it *available* and is making it *truly* economic.

We see no reason why similar demonstrations cannot be conducted in other lines of economic entomology. We note with interest that Mr. E. P. Taylor is doing something similar in Missouri in spraying for San José scale. The Geneva (N. Y.) Station has long conducted tests in potato spraying, which only lack the feature of publicity and audiences to make them true demonstrations. In Maryland Mr. Symons sprayed many orchards for the growers at cost prices. A very similar work is being carried on in Pennsylvania by Professor Sur-



Spraying demonstrations, 1909, in North Carolina, showing the audiences that gathered at three of the meetings.

face. The object-lesson method is the favorite one among entomologists in the class-room. Why not in the field application of our work?

This demonstration work is *not experimental work*. We use only the methods that are well established and proven beyond controversy; it involves nothing new, doubtful or investigational. We studiously avoid, for the sake of simplicity, the finer points of detail of which even entomologists are yet uncertain. Nor is it the same as the practical field test, since in field test work there is no invitation to the public to attend, watch and question.

No doubt there are states where such work as this would appeal to a smaller class than it does here. But we doubt whether there is a single state in which the *majority* of the orchards which are set for market purposes are sprayed systematically. We grant that the majority of the commercial growers may spray, because they have learned how, but there are hundreds who set out market orchards and whose orchards fail and remain utterly neglected because the benefits of spraying are never brought home to them in sufficiently forcible manner to be convincing.

NOTES ON MITES AFFECTING CHICKENS

By GLENN W. HERRICK

The young chickens in the poultry yards at Agricultural College, Mississippi, have been curiously affected for the past two summers with a species of mite, or what is known in common parlance as "red-bugs."

On May 28, 1908, we examined two young chickens that were evidently diseased and found the sides of the body, beneath the wings where the feathers were scarce, bearing, here and there, rather large red nodules or tubercles, usually capped around the edges of the top at least with a hard scab or crust. In the center of the crust of each tubercle we found the red distended abdomens of numerous mites, with their heads buried in the tissues. When the scab was removed the mites came with it and left a comparatively large cavity in the center of the tubercle.

The mites were evidently gregarious and their presence in such numbers had stimulated the tissues until the nodule had been formed. Within the nodules were masses of whitish, fat-like tissue, composed of long, tapering cells. The mites were almost buried in these masses. Occasionally we found one isolated mite, especially between the secondary quill feathers of the wings. In each case its head was buried in the flesh like a tick.

On June 17 we examined other chicks from the same brood, which were now, of course, somewhat larger.

On chick No. 1 we found nodules now healing from which the mites had evidently escaped. We also found fresh tubercles on the sides of the body with mites in them, also isolated mites on the under sides of the wings.

On chick No. 2, on the right side of the abdomen, I found two very large tubercles. On one of them I counted the red abdomens of seventeen mites closely packed together like red berries, with their heads buried in the tissues of the tubercle like ticks.

On chick No. 3 I found a very large tubercle, showing the bodies of nine mites, and on chick No. 4 a tubercle was found with the bodies of nineteen mites clustered at the apex. All of these chickens were affected with other smaller clusters of mites, and with a few isolated ones on the under sides of the wings.

I submitted specimens of these mites to Mr. Banks for identification, and he wrote that they were "Leptus, that is, the larvæ of Trombidium. No species have as yet been bred in this country, so it is impossible to tell to what species your material belongs."

Professor Kerr, in observing the effect of these mites on the young chickens, says they soon succumb to the mite attacks. The chick seems to contract a diarrhœa, grows weaker and weaker, and finally dies. He thinks these mites are responsible for a high mortality among chickens in the South.

It is quite probable that these mites breed among weeds and tall grass, where the sun's rays cannot penetrate and where moisture conditions are favorable. It seems to me that young chicks liable to attacks from these mites should be confined to areas kept clear from weeds and tall grass. The mites will not be apt to breed in closely cropped grass and in an absence of shade. The heat of the sun would probably prevent their development.

INSECTS AND LEGISLATION

By E. P. Felt, *Albany, N. Y.*

It is interesting to note the effect of insect depredations upon legislation by our state and federal governments. The early laws provided simply for the study of injurious insects and plant diseases and for the dissemination of information concerning them through the press by means of reports and bulletins. Dr. T. W. Harris of Massachusetts was the first American entomologist to receive compensation from

e state for his reports, though there was no official entomologist in that state till 1870. New York led in 1854 by the appointment of Dr. Asa Fitch as entomologist to the State Agricultural Society, followed closely by the federal government the same year and by the states of Illinois and Missouri, making provisions for the work of official entomologists in their legislative sessions in 1866–1867 and 1867–1868, respectively.

These earlier workers, though poorly compensated and hampered by numerous and unnecessary restrictions, paved the way for the more comprehensive legislation of later years. California was a leader in enacting a general horticultural law, designed expressly for the control of the codling moth and other dangerous fruit pests. In 1895 there were only four states—and they western—which had general horticultural laws, while four others, Missouri, Kansas, Minnesota and Nebraska, had enacted special legislation, prompted by the extensive ravages by grasshoppers. But two states, namely, New York and Utah, had at that time made any legal provisions for the control of foul brood.

The discovery of San José scale in the eastern United States in 1893 and the subsequent alarm among horticulturists resulted in the enactment of numerous state laws, designed expressly to regulate the traffic in nursery stock and thus prevent the free dissemination of this pest. This is well illustrated by the fact that in 1898 fifteen states had enacted general horticultural laws, designed expressly to control injurious insects and for the most part directed against San José scale. Subsequent years witnessed great activities among legislators with horticultural interests, and in 1908 there were some thirty-nine states and territories which had in some way or other made legal provisions for the control of traffic in nursery stock.

Meanwhile the gipsy moth and the brown-tail moth had become well established in Massachusetts and adjacent states, and, as a result, all of the New England states and New York have made more or less comprehensive provisions for the control of one or both of these pests. Similarly the discovery of the boll weevil in Texas, and the danger of its spread to adjacent cotton-growing states, has resulted in legislation by Louisiana, Alabama, Georgia, Mississippi and South Carolina.

It requires no great mental acumen in tracing the above history to discover a distinct relation between cause and effect. Most, if not all, of the horticultural laws now current in the United States are the result of an insistent demand by a more or less extensive constituency. The first enactments were designed to meet the necessities of a serious

situation. The laws specifically provided for the control of certain injurious forms, and in some instances at least prescribed the methods of control. The experience of recent years has demonstrated the wisdom of more general acts, placing large discretionary powers in the hands of an executive officer. Furthermore, legislation originally designed solely for the control of either insect pests or fungous diseases has been broadened and amplified so as to include both. A few states have placed the control of insect pests and fungous diseases in the hands of separate officials.

The exact method of administration is not so important, provided there be a substantial harmony between the requirements of the individual states. No argument is necessary to demonstrate the wisdom of this, since it means a great saving of time and expense to shippers and dealers in all stock subject to examination and eventually a corresponding economy to the purchaser. Earlier legislation has been marked by greater or less divergence, while subsequent amendments have gone far toward producing a reasonable degree of harmony. The advantage of general provisions with large discretionary powers for the executive officer lies in the fact that the latter can readily modify requirements to meet the necessities of ever-changing conditions. An insect which may be rightfully regarded as a serious menace today may, a few months or years later, be ranked as of comparatively little importance so far as its shipment into a certain state or section of a state on nursery stock is concerned, owing to the fact that the territory under consideration may be generally infested and the introduction of a few more individuals be of comparatively slight moment. The earlier tendency of the western states was to establish the county system of inspection, doubtless due to the fact that certain counties possessed much more important horticultural interests than others. The tendency of some of these states at least has of late years been to strengthen the hands of the state authorities and make the county officials complementary thereto. The county system has not prevailed in the East, the universal tendency being to put the work in the hands of a state official.

The special conditions caused by the presence of the gipsy and brown-tail moths in New England has resulted in diverse legislation. The earlier efforts aimed at extermination. The later work has for its object control, and is based upon a somewhat elaborate plan of cooperation between state, municipal, village and town authorities. The state supervises the work and, if its requirements are met, partially reimburses the community, the refund being to a certain extent inversely proportional to the amount of taxable property. The federal

government, justly recognizing the danger of these insects spreading to other states, is assisting by giving particular attention to the prevention of the further spread of the insects. In addition, both the commonwealth of Massachusetts and the federal government are cooperating in a comprehensive scheme for the introduction and study of natural enemies of these pests in the hopes of securing some efficient natural check upon the hordes of devastating caterpillars.

The presence of the boll weevil in the cotton-growing fields of the South has wonderfully stimulated popular interest in entomological investigations and has resulted in the establishment of excellent quarantine regulations against this insect. A secondary development has been the greatly increased interest in the general work of the economic entomologist and more adequate provision for local investigations of that character.

Another incidental outcome of insect legislation is the enactment of laws regulating the purity of insecticides. This is but the logical sequence to the fertilizer laws now in force in many states and the pure food law of the general government.

The recent introduction of brown-tail moth caterpillars on nursery shipments from abroad has emphasized most strongly the necessity of quarantine regulations upon the Atlantic coast. This occurrence is but one of a series which amply justifies this nation in protecting itself from dangerous insects as well as destructive fungi. It is only a question of time before some such legislation will be enacted. Those responsible for the bill will undoubtedly draft a comprehensive measure which will afford ample protection without inflicting unnecessary restrictions. State legislatures are exhibiting greater friendliness toward comprehensive measures since they have become acquainted with the beneficial results which may follow, and it is to be expected that marked progress toward efficiency and moderate uniformity in requirement will accompany all subsequent amendments.

SOME NEW RECORDS OF APHIDIDAE IN NORTH AMERICA

By H. F. WILSON, *Agent and Expert*

INTRODUCTION

In the following pages the writer desires to redescribe a little known aphid which is remarkably divergent from other forms of the family Aphididæ and also to give data regarding two species known for many years to occur in Europe but which have not been recorded hereto from North America.

A NEW APHIS ENEMY OF BANANAS

Pentalonia nigronervosa Coquerel[1]

A species of Aphidæ has been found very abundantly on banana plants in the greenhouses of the United States Department of Agriculture and was without doubt imported on banana plants from some country where this fruit is grown.

Pentalonia nigronervosa Coq.

Winged viviparous female (Fig. 1).—General color reddish brown, eyes dark red, legs as long or longer than the body, antennæ reaching beyond the body and honey tubes; antennæ, nectaries and distal ends of the femora and tibiæ dusky red; remaining parts of the legs opaque, with a slight reddish tinge.

Antennæ situated on prominent tubercles, which are strongly gibbous on the inner side; segments 1 and 6 equal in length, 3 equal in length to 4 and 5 together, and both with ten or twelve round sensoria placed in a somewhat irregular line along the inner side of the segment; 4 somewhat longer than 5 and with six small sensoria, three of them near the middle and three toward the distal end; 7 long and slender, with two bristlelike hairs at the base; wings hyaline; veins distinct and bordered by dusky bands.

Venation of the wings varying considerably in individuals and often in opposite wings of the same specimen; first and second oblique veins nearly parallel, running transversely across the wing; cubital vein two-forked and distorted at or near the second fork, where the stigmal vein joins it, the two forming a single vein for a short distance, then separating and forming a distinct stigma and a cubital vein. The fusing of these two veins also forms a closed cubital cell, which may or may not be called a true wing cell.

Nectaries about as long as third antennal segment and reaching slightly be-

[1] Ann. Soc. Ent., France, p. 279 (1859). Fig.

and the cauda; on live specimens semi-erect and pointing inward; general form cylindrical, slightly constricted in middle and at a point just beyond the tongelike end; cauda very short and ending in a globular tip.

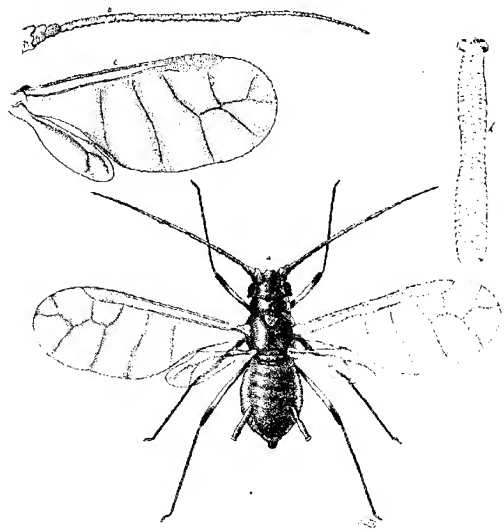


Fig. 7.—*Pentalonia nigronervosa; a*, winged viviparous female; *b*, antenna; *c*, wings; *d*, cornicles—*a* enlarged. *b*, *c* and *d* greatly enlarged (original).

Measurements: Length of body, 1.5 mm; width, .75 mm; length of antennal segments (1) .08 mm, (2) .08 mm, (3) .46 mm, (4) .30 mm, (5) .20 mm, (6) .09 mm, (7) .30 mm; total length, 2 mm; length of femora on hind leg, .75 mm; tibia and tarsi, 1.25 mm; nectaries, .3 mm; cauda, .07 mm.

Wingless viviparous female (Fig. 8).—General color light reddish brown; tip of antennæ and distal ends of femora, tibiæ and nectaries dusky; remaining parts of antennæ and legs opaque, with a reddish tinge.

Antennæ long, reaching back over the body past the ends of the nectaries; segments 2 and 6 equal in length, 7 as long as 3 and 4 together; antennal tubercles prominent and gibbous on the inner side; inner side of tubercles and front of head forming three sides of a rectangle; head with a slight elevation in front, on each side of which arises a short bristle. Nectaries slightly thicker than those of the winged forms but of the same length; cauda short, ending in a globular tip.

Measurements: Length of body, 1.20 mm; width, .75 mm; length of antennal segments (1) .09 mm, (2) .06 mm, (3) .36 mm, (4) .20 mm, (5) .18 mm, (6) .07 mm (7) .50 mm; total length, 1.55 mm; nectaries, .30 mm; cauda, .06 mm.

Winged male (?).—The male as described is questionable. Many small-bodied individuals were found on the plants with the winged and wingless females. On account of the size of the abdominal cavities, which would not seem to permit the development of young, the small individuals were taken to be males.

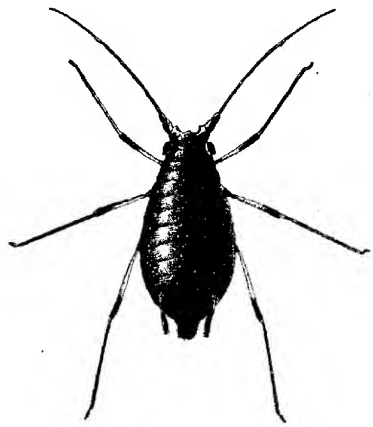


Fig. 8.—*Pentalonia nigronervosa*, wingless viviparous female, enlarged (original).

General coloration of parts same as in winged female, but antennæ without dusky tips. Antennal segments 2, 3 and 4 together as long as 7, which is long and slender, with a single short bristle at the tip.

The average measurements of five specimens are as follows: Length of body, 1.09 mm; width, .45 mm; length of antennal segments, (1) .07 mm, (2) .06 mm, (3) .36 mm, (4) .23 mm, (5) .20 mm, (6) .07 mm, (7) .64 mm; total length, 1.63 mm; length of wing, 1.8 mm; width of wing .70 mm.

Pupa. Similar to the wingless female and with gray wing-pads.

An ant, *Prenolepis parvula* Mayr, a common species about the department greenhouses, is an attendant on this aphis.

AN APHIS OCCURRING ON ANGELICA AND IVY

Aphis angelicæ Koch

Specimens of *Aphis angelicæ* Koch have been received by the Bureau of Entomology on numerous occasions for determination, but there is as yet no published record of its occurrence in the United States. Koch gives as its food plant in Europe *Angelica sylvestris*. In California it is recorded from *Angelica* sp. and ivy.

Winged viviparous female (Fig. 3).—General color grayish green, the gray being due to a pruinose secretion on the body; wings hyaline, veins clear; first 3 segments of antennæ, tip of beak, distal ends of femora and tibiæ and nectaries dusky yellow; eyes and thorax dark brown; last two segments of antennæ and the abdomen green. The abdomen of some specimens has 4 transverse, dusky dorsal bands, the edge of the fourth band coinciding with the base of the nectaries. These bands do not extend entirely across. They often merge to form an oblong black patch. An orange-colored band crosses the abdomen between the nectaries and seems to be fairly constant in all specimens.

Eyes semi-prominent; beak reaching beyond the second pair of coxæ; nectaries short and cylindrical; cauda obtuse, set with a few short hairs; antennæ shorter than body and very much roughened along segments 3, 4 and 5 by numerous irregular sensoria; segment 3 with thirty to forty prominent sensoria, 4 with ten to fourteen, and 5 with one large sensorium always present and occasionally also one very small one; segments 1 and 2 equal in length; segment 3 longest, slightly longer than 6 and 7 together.

Measurements: Length of body, 2.30 mm; width, .95 mm; length of wing, 3.15 mm; total expanse, 6.9 mm; length of antennal segments, (1) .07 mm, (2) .07 mm, (3) .40 mm, (4) .23 mm, (5) .15 mm, (6) .11 mm, (7) .26 mm; total length, 1.35 mm; length of nectaries, .16 mm; cauda, .13 mm; width of cauda at base, .10 mm.

Wingless viviparous female.—General color green, covered with a fine gray pruinosity which gives them a dark appearance; eyes dark red; femora, tibiæ, antennæ, nectaries and cauda dusky; remainder of body green; abdomen with a deep orange spot at the base of each nectary, and two or three transverse dusky bands crossing just behind the nectaries; antennæ and head with a few short hairs; cauda obtuse; antennæ less than half as long as the body, segment 2 being the shortest and 7 the longest; nectaries cylindrical and shorter than in winged specimens.

Measurements: Length of body, 2.6 mm; width, 1.2 mm; length of antennal segments, (1) .09 mm, (2) .06 mm, (3) .23 mm, (4) .13 mm, (5) .1 mm, (6) .09 mm, (7) .27 mm; total length, .95 mm; length of nectaries, .24 mm; cauda, .7 mm; width of cauda, .08 mm.

Pupa.—General color green; antennæ and tibiæ dusky at distal ends; eyes black; in other respects similar to wingless females; length of body, 2mm; length of antennæ, .9mm.

AN APHIS ON MAPLE IN CALIFORNIA

Drepanosiphum platanoides Schrank

Specimens of a large and beautiful aphis (*Drepanosiphum platanoides* Schrank) were sent to this bureau during the year 1908 by several correspondents on the Pacific coast. This species does not seem to have been noticed previously in North America by anyone interested in the study of aphides, and since all the specimens at hand came from California perhaps it does not occur in the more eastern states.

In the year 1848 Francis Walker[1] gave an account of the life his

[1] Ann. and Mag. Nat. Hist. (2), vol. 1, p. 250–254.

tory in England and mentioned ten varieties of the species, suggesting that there is evidently quite a variation in color and size.

A very interesting difference of form is noticeable in the viviparous and oviparous females, in the shape of the body, the former being stout and short and the latter long and spindleshaped. Prof. C. P. Gillette, in describing a new species of this genus, *Drepanosiphum braggii*, figures the egg-laying female of that species, which shows the elongate spindleshaped abdomen, and explains the method of egg deposition.

Descriptions of the forms at hand taken on maple (*Acer* sp.) at Lorenzo, Cal., by Mr. I. J. Condit are given below:

Winged viviparous female.—General color reddish yellow; head at base, dorsal plates of thorax, joints of legs and tarsi dark; femora and tibiæ dusky orange; antennæ dusky at base, paler at tip; nectaries yellow, with dark tips; cauda reddish yellow; wings hyaline, long, and held in horizontal position when at rest; stigma opaque; veins dusky, ending in indistinct dusky margins.

Antennæ long and slender, almost twice as long as the body, and set on large prominent tubercles; segment 3 as long as 6 and 7 together, and with fifteen to twenty or more elliptical sensoria placed in a regular line along the upper outer edge of the basal half of the segment; segment 5 with one large sensorium near the distal end; 6 with three to five large sensoria irregularly placed on the segment and distinctly separated from each other; all the segments set with short, spinelike bristles; tip of segment 7 with two setaceous hairs; head broad, with two long and two short hairs in front; the two ocelli adjoining the eyes quite prominent and having a dusky ring around the base of each.

Prothorax long, with several tuberculate hairs on each side; abdomen robust, set with numerous short hairs arising from prominent tubercles. Legs set with numerous short hairs; tibiæ long and slender, femora short and stout.

Nectaries slightly curved outwardly and swollen in the middle. Cauda short and conical.

Measurements: Length of body, 2.72 mm; width, 1.04 mm; length of antennal segments, (1) .20 mm, (2) .08 mm (3) 1.6 mm, (4) 1.2 mm, (5) .84 mm, (6) .15 mm, (7) 1.4 mm; total length, 5.47 mm; length of wings, 4.8 mm; total expanse, 10.32 mm; length of nectaries, .96 mm; cauda, .2 mm.

Winged oviparous female.—General color reddish yellow to yellow; head, antennæ from middle of segment 3 to end of 6, distal ends of femora and tarsi dusky; ends of nectaries dusky orange; dorsal and ventral plates of thorax dark brown. The general characters are similar to those of the viviparous female, with the exception of the abdomen, which is longer and is spindle-shaped. This form probably does not occur until fall, but as late as November the viviparous forms can be found on the underside of the leaves. Length of body, 3mm; other measurements as in winged, viviparous female.

Pupa.—The pupæ of both forms are similar to each other, except as to the shape of the abdomen, which in the one case is robust and in the other spindle-shaped. Color light reddish throughout.

PLANT LOUSE NOTES, FAMILY APHIDIDAE; PLATE 12

By C. P. GILLETTE

On June 21, 1909, the writer left Fort Collins for a trip east, and made short stops at Chicago, Illinois; Lansing, Portland and Detroit, Michigan; Rochester, Geneva, Albany and New York City, New York; Palisades, near Fort Lee, New Jersey; and Washington and Georgetown, D. C., for the purpose of collecting and taking notes upon species of Aphididæ and seeing as many types as possible. In the same month Mr. L. C. Bragg started upon a vacation trip east, during which he made collections and notes on Aphididæ at Lawrence, Kansas; Kansas City, Missouri; Union City, Indiana; Springfield, Amherst and Wood's Hole, Massachusetts; and then, between August 18th and 27th last, the writer collected aphids at Portland, Hood River, Oregon City, Dundee, Corvallis and Salem, Oregon; and Seattle, Washington. The notes cover more than one hundred species and the object of this paper is to bring the more important of these notes together, with brief comments upon the occurrence of the same species so far as we have taken them in Colorado.

To avoid repetition, I will give here, once for all, the dates at which captures were made at the different points visited.

The dates of Mr. Bragg's collections were: Lawrence, June 5 to 10; Kansas City, June 11 and 12; Union City, Ind., June 13; Springfield, June 14 to 16; Amherst, June 16; Webster, June 17 to 28; Wood's Hole, June 28 to July 5.

My dates were: Chicago, June 23; Lansing, June 24; Portland, Mich., June 25 and 26; Detroit, June 27 and 28; Rochester, June 29; Geneva, June 29 and 30; Albany, July 1; Central Park, N. Y., July 2; Palisades, near Fort Lee, July 2; Washington and Georgetown, July 3, 4 and 5; Portland, Ore., August 18 to 20; Hood River, August 21; Oregon City, August 22; Dundee, August 23; Corvallis, August 23 and 24; Salem, August 24; Seattle, August 27.

I was specially helped in this work by Mr. J. J. Davis in Chicago, Dr. E. P. Felt at Albany, Doctor Beutenmuller at Palisades and Mr. H. Wilson at Washington and Georgetown.

FITCH'S TYPES

While at Albany Doctor Felt kindly unsealed the case of Fitch's types for my inspection. I had wondered how it happened that Fitch always had males of his plant lice to describe. An examination of his types indicates that, to Fitch, all winged lice were males, as will appear from the following notes:

Notes on Types Examined

"*Aphis mali*, male, No. 839." In very poor condition but one hind wing is still present, showing the specimen to be a viviparous female.

"*Aphis cerasi*, male, No. 840." In too poor condition for determination.

"*Aphis berberis*, No. 842, male; 840, female." In too poor condition for determination.

"*Aphis brassicæ*, male, No. 844." In very bad condition but with wings present.

"*Aphis rudbeckiæ* (*Macrosiphum*), male, No. 853." An alate louse in fair condition.

"*Aphis lanigera* (*Schizoneura*), male, No. 861." A winged louse, evidently the viviparous pre-sexual form.

"*Aphis pyri* (*Schizoneura*) male, No. 862." Winged viviparous female, like preceding.

"*Aphis imbricator*, male and female." The wing of the supposed male has true *Pemphigus* venation.

The specimens are all mounted on cardboard points on pins.

FIELD NOTES

Chermesinae

Phylloxera c-venæ Fitch. Abundant on hickory leaves at Rochester and Georgetown. Galls along midrib or main veins and usually near the margin of a leaf. Within were eggs, larvæ and pupæ; none alate at Rochester. Syrphus larvæ were also common in the galls. Stem females, eggs and alate adults were in the galls at Georgetown. The eggs and stem females are very pale yellow, almost white; pupæ dusky yellow.

Phylloxera c-fallax Walsh. Noticed at Rochester only on hickory leaves. Many of the lice were alate; galls abundant.

Phylloxera intermedia Perg. Taken on hickory leaves at Rochester and Geneva, N. Y., and Georgetown, D. C. At Rochester stem-mothers, eggs, larvæ, pupæ and alate adults were abundant.

Phylloxera vastatrix Planchon. Galls on leaves of wild grape vines, common at Portland, Mich., Geneva and Georgetown.

Chermes abietis L. Abundant on Abies nigra in City Park, Albany, July 29. None of the lice ready to leave the galls, though many are pupæ. The very pale yellow, almost white, color of larvæ and the position of the galls, not terminal, are conditions quite in contrast with the rusty brown lice and the terminal position of the galls in case of *Chermes cooleyi*. Galls also taken at Geneva.

I have seen a few small galls of this species in City Park, Denver, upon spruces brought from the East.

Chermes laricifoliæ Fitch. Rather abundant on *Larix americana* on campus of Michigan Agricultural College and at Geneva.

Chermes pinicorticis Fitch. On *Pinus strobus* at Lansing and at Albany. It is commonly very abundant in City Park, Denver, upon the same pine.

Pemphiginae

Tetraneura ulmicola Fitch. At Lawrence, just beginning to get wings; at Geneva galls very common, some turning red and in these were many alate lice and pupæ. In the green galls all were nymphs. Many galls of this species were also seen at Washington. Have once seen galls of this species in Fort Collins upon an elm from an Iowa nursery, set the foregoing spring. Figs. 1, 2.

Hamamelistes spinosus Shimer. The powdery apterous form of this louse was taken in abundance upon the under side of the leaves of white birch at Albany. At Washington the spiny galls were taken from witch hazel (*Hamamelis virginica*) along with the galls of *Hormaphis hamamelidis*. The galls were reddish, and were packed with lice of about the same color. In each was found a very robust, almost globular, stem-mother and lice of all stages, including the winged form.

Since my return Mr. O. G. Babcock, a special student in entomology, on August 2 brought me from the foothills near Fort Collins, at an altitude of 7,000 feet, several leaves of the mountain birch (*Betula fontinalis*) upon which were colonies of Hamamelistes that seem in every way to agree with the characters of *spinosus*. This seems strange as the witch hazel family is not known to occur in the Colorado fauna for the alternate form of this species, which would seem to be necessary according to the careful work done by Mr. Pergande upon this louse in the East. It is possible that the Colorado form may be a distinct species with a different alternate food plant not yet discovered. Upon the other hand it is possible that this louse is able to continue from year to year upon the birch. We have found that many lice which have the habit of alternating their host plants are able to continue indefinitely upon one of them. Migration to a new food plant in early summer seems to be for the purpose of getting away from natural enemies that have rapidly increased upon the winter host, and this habit is probably a comparatively recent development. So it is not strange that in many species we find this migrating tendency failing to be universal among the individuals of a colony. *Chermes cooleyi*, during early July, almost completely leaves the blue

spruce to go to the red spruce, but only about 50 per cent. of the fou (*var coweni.*) on red spruce migrate to the blue spruce each June.

Phorodon humuli and *Hyalopterus arundinis* winter upon the plum and leave in early summer for herbaceous plants, but we have found occasional colonies of both these species continuing throughout the summer on plum foliage; *P. humuli* is known also to spend the entire year upon the hop. *Aphis bakeri* uses the apple and the thorn (*Crataegus*) as its winter hosts and the clovers for its summer food plants, but we find it remains commonly upon red and white clovers throughout the year in protected places, and occasional late summer colonies have been found upon apple sprouts. Other similar cases might be added to the list. Fig. 3.

Hormaphis hamamelidis Fitch. The smooth cone-shaped galls of this species were taken in great numbers upon leaves of witch hazel at Washington, Webster, and Wood's Hole. The galls contained one stem-mother and in each case examined many of her offspring in all stages of growth including adult winged examples. In color these lice resemble those in the spiny galls of the preceding species. Fig. 4, 5.

Pemphigus betae Doane. Taken at Salem, Oregon, where it was common upon roots of *Chenopodium album* in an apple orchard. Apterous form and pupæ were seen, but none that were alate.

This is a serious sugar beet pest in Colorado occurring upon the eastern and western slopes. So far as I can learn this species does not occur much east of the eastern line of Colorado. We find the native asters and golden rods (*Aster* and *Solidago* sp.) favorite host plants, while it is also common on the roots of *Chenopodium* and *Iva*. Sensoria on antennal joints about as follows: three, 6 to 7; four, 2; five and six, 1 each. See fig. 6.

Pemphigus fraxinifolii Riley. This louse is very common upon white ash in Colorado, but we did not meet with it anywhere east of Colorado. I found the louse and its injuries very common upon the native ash (*Fraxinus oregona*) about Portland, Oregon. It seemed specially abundant upon little trees that were but a few feet high, tightly curling the leaves, many of which were dead. Sensoria: joints three, 5 to 7; four, 4 to 5; five, 5 to 6; six, 2 to 3. Fig. 7.

Pemphigus acerifolii Riley. Mr. Harley Wilson showed me this species at Georgetown on silver maple (*A. dasycarpum*). The lice had nearly all left the folded leaves which they had inhabited, and the leaves had ripened and fallen. Some large trees had been badly infested. This is a very large species, measuring as much as 4.50^{mm} in body length and spanning fully 10^{mm} from tip to tip of wings. The antenna is very short, barely exceeding 1^{mm}, and the sensoria are con-

fined to the under surface of the segments, there being only slight indications of the sensoria from above. The numbers of sensoria per segment are about as follows: Joints three, 11 to 13; four, five and six, 5 to 6 each. Fig. 8.

Pemphigus corrugatans Sirr. This species seems common and widespread, curling the leaves of *Crategus* and *Amelanchier*. It was abundant in curled leaves of *Crategus macrocapetra* and *C. crusgalli* at Lansing, and leaves of *Amelanchier canadensis* at Kansas City, Springfield, and Webster. Alate lice was found in all cases. This is a common species upon *Amelanchier alnifolia* and *Crategus occidentalis* in the foothills near Fort Collins and upon what I take to be the same plants at Paonia, Colorado. Sensoria: Joints three, 16 to 20, four, 4 to 6,; five 2 to 3; six, 1. Fig 9.

Pemphigus ulmifusus Walsh. The galls of this species were shown to me by Dr. Bentenmuller of Palisades, N. J. The leaves of a small elm were much infested, the larger galls being fully two inches in length. Just an occasional gall was beginning to turn yellow, and in these some alate examples were found. In all the galls stem-mothers were still present; they were very pale yellow in color, large and sub-globular. All of the descendants from the stem-mother were acquiring wings. This gall was abundant on small elms at Washington, but the inmates had escaped. At Woods Hole alate lice were abundant in the galls.

The alate lice I took were larger than those Thomas described (Eighth Ill. Rep. p. 153), averaging 1.60^{mm} in body length and fully 2.20^{mm} to the wing tips, and I find no well marked indication of a fork to the cubital vein. The antenna has joints 3, 4, 5 and 6, all heavily ringed, joint 4 being usually the shortest and 5 and 6 subequal. The most pronounced peculiarity of the antenna is the absence of a distinct unguis as a differentiated portion of joint 6, resembling in this respect, *Hamamelistes*. Fig. 10.

Pemphigus tesselata Fitch. This species was taken by Mr. Bragg from the underside of limbs of alder at Webster and Woods Hole. Apterous examples only were seen.

Pemphigus populitransversus Riley. Taken on cottonwood leaves at Rochester and at Webster. Very few galls seen. This is a common species infesting cottonwoods in Colorado. Sensoria: Joints three, 3 to 5; four, 0–1; five and six, 1. Sensoria in distal portion of joints 5 and 6 very large, with 2 to 4 minute hairs in each. Fig. 11.

Pemphigus populiconduplifolius Cowen. Stem-mothers and young of what seem to be this species were taken in folded leaves of *populus*

balsamifera at Lynn, Mass., June 27. Sensoria: Joints three, 20 to 25; four, 6 to 8; five, 6 to 7; six, 5 to 7. Fig. 12. Drawing from Colorado specimens.

This louse is of occasional occurrence in Colorado upon the broad leaved cottonwoods. The upper surface of the leaf folds together along the line of the midrib and the sides puff out like a well filled purse.

Pemphigus populimonilis Riley. Not noticed east, but was very common upon terminal leaves of *Populus trichocarpa* about Portland, Oregon. Many of the little pockets were dissected and in some syrphus larvae were seen, but in others were the living lice, one in a gall. All acquire wings. Apparently the young migrate from the gall almost as soon as born and start a home of their own by the irritation that their beaks produce in the growing leaf. This species is extremely abundant upon young narrow-leaved cottonwoods (*P. angustifolii*) in Colorado. Sensoria: Joints three, 6 to 9; four, 3 to 5; five, 1 to 3; six, 1. Fig. 13. From Colorado specimens.

Pemphigus vagabundus Walsh. A single gall, quite immature, was taken from cottonwood at Rochester.

This species is comparatively rare in Colorado, but occasionally a small tree is quite badly infested. The antenna has a very long unguis for this genus and what is more remarkable the unguis seems to have three sensoria. See Fig. 12. Sensoria as follows: Joints three, 10; four, 2; five and six, 1 each; unguis 3. From alate lice taken at Chicago, Ill., by J. J. Davis, and at St. Louis, Mo., by J. T. Monell. Fig. 14.

Schizoneurinae

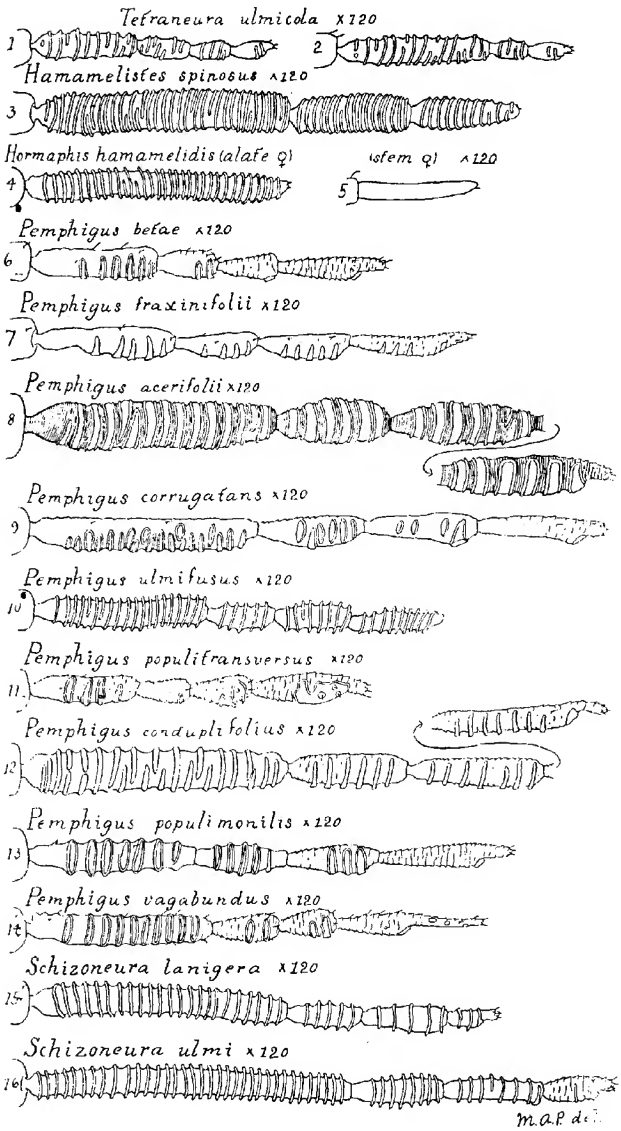
Schizoneura lanigera Hausm. This species, almost universally present in apple orchards, was not specially searched for but was noticed at Geneva, Central Park, Washington and Lawrence, and was nowhere very abundant. This is one of the most serious and generally distributed insect pests of apple orchards in Colorado. Mr. Bragg found the alate pre-sexual form at Lawrence. So far as I know this is the earliest date for the alate form. Mr. George P. Weldon reported an alate louse of this species at Austin, Colorado, July 15, 1909. Figure 15 shows an enlarged antenna.

Schizoneura ulmi L. (*americana* Riley). Many alate lice and nymphs in rolled leaves of American elm at Geneva, Albany, Lawrence and Wood's Hole. The curled leaves were also seen at Washington and Georgetown, and on European elm (*Ulmus campestris*) at Corvallis. This louse is a real pest upon white elm nearly everywhere that this tree is grown in Colorado. The antenna is shown in Fig. 16

Schizoneura rileyi Thos (*ulmi* Riley). This louse was described from the tender growing bark of the elm by Dr. Riley and was seen by Mr. Bragg at Wood's Hole; it is also of common occurrence at Fort Collins and other places in Colorado. I am unable to separate it with any certainty from *ulmi*, so incline to believe the two forms are one species.

Galls were taken at Corvallis on *Ulmus campestris*, or European cork elm, that were very large pocket-like swellings, often involving the entire leaf and with a large wide open mouth below. As the few alate lice taken seem not to be specifically distinct from the specimens we have taken from the common form of this gall on the American elm, I am not considering it a different species.

Plate 12. Antennæ of Aphididæ. All alate viviparous females, except Fig. 5. All enlarged 120 diameters. One and 2 are 6 and 5 jointed antennæ from the same individual of *Tetraneura ulmicola*; 3, *Hamamelistes spinosus*; 4, from alate form and 5 from apterous stem-mother of *Hormaphis hamamelidis*; 6, *Pemphigus betæ*; 7, *P. fraxinifolii*; 8, *P. acerifolii*; 9, *P. corrugatans*; 10, *P. ulmifusus*; 11, *P. p-transversus*; 12, *P. p-conduplifolius*; 13, *P. p-monilis*; 14, *P. vagabundus*; 15, *Schizoneura lanigera*; 16, *Schizoneura ulmi*. Original, Miriam A. Palmer, delineator.



ANTENNAE OF APHIDIDAE

CALIFORNIA HORTICULTURAL QUARANTINE

By C. W. Woodworth, *Berkeley, Cal.*

Entomologists are generally unacquainted with the actual facts relative to the working of the California horticultural laws. The supposition is that they have really prevented the introduction of insects. During the period of the greatest horticultural expansion California had absolutely no restrictions on importations. The quarantine laws have been effective now for more than a score of years. In 1896 Mr. Alexander Craw, then horticultural officer at the port of San Francisco, gave a list of "injurious insect pests found on trees and plants from foreign countries."[1] These were the insects which he considered liable to be introduced but which the quarantine was expected to prevent.

The publication of a "Host Index of California Coccidæ" by Essig and Baker[2] contains data for checking up the preceding list, largely supplied by Mr. Edward M. Ehrhorn, the successor of Mr. Craw. The following species are noted as established in California:

1. *Pseudaonidia duplex* Coc. (*Aspidiotus duplex*) in greenhouses (p. 56).

2. *Chrysomphalus aonidium* Linn (*Aspidiotus ficus*) in greenhouses (p. 55).

3. *Hemichionaspis aspidistræ* Sign. (*Chionaspis aspidistra*) in greenhouses (p. 55).

4. *Chionaspis euonymi* Coms. in nursery houses (p. 60).

5. *Fiorinia fiorinæ* Coms. (*Fiorinia camelliæ*) in greenhouses (p. 56 and 58).

6. *Lepidosaphes beckii* Newm. (*Mytilaspis citricola*), recorded by Craw as already established in one locality in San Diego County and eradication urged, on orange (p. 57).

7. *Lepidosaphes gloveri* Pack (*Mytilaspis gloveri*), same record as above, on orange (p. 57).

8. *Parlatoria pergandei* Coms. on orange and camellia (p. 56 and 57).

9. *Pseudococcus aurilanatus* Mask (*Dactylopius aurilanatus*) in greenhouses (p. 59).

10. *Eucalymnatus perforatus* News. (*Lecanium perforatum*) in greenhouses (p. 56), on sweet bay tree (p. 62).

11. *Orthezia insignis* Doug. on Lantana (p. 61).

[1] Fifth Biennial Report of the State Board of Horticulture.

[2] Pomona Journal of Entomology, Vol. I.

This list constitutes nearly a third of those mentioned by Craw, and does not by any means include all the species that have become residents of the state during this interval. The horticultural officers were particularly on guard against these scales, but they nevertheless found admittance. These facts do not reflect upon the care of our horticultural officers because their work has always been most painstaking and earnest, but do seem to indicate the futility of such effort.

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

The twenty-first annual meeting of the American Association of Economic Entomologists will be held in Boston, Mass., during the last week in December, 1909. A further notice will be sent to all members before the first of November, together with a blank to be filled out by all members desiring to present papers at the meeting. In order that the program can be made up so that it can appear in the next issue of the JOURNAL and in the general program of the American Association for the Advancement of Science, it is necessary that the blank be filled out promptly and returned to the secretary.

Application blanks for membership should be secured from the undersigned at once so that they can be filled out and returned in advance of the meeting. This will greatly facilitate the work of the Membership Committee.

The meeting at Boston promises to be one of the best held by the association and it is hoped that the entomologists from all sections of the country will make it a point to be present.

A. F. BURGESS, *Secretary*,
Bureau of Entomology, Washington, D. C.

Discussion and Correspondence

The JOURNAL has endeavored to maintain an independent attitude and at the same time accord fair and courteous treatment to all. It is impossible for the editor to personally verify all statements submitted in manuscript. He can only hope to exclude the more patent errors. Authors, including those submitting reviews, must be held responsible for their statements, provided the copy has been followed.

The following communication, dated at Cambridge, England, July 27, 1909, and addressed to the editor, requires no explanation:

"We notice in your issue of June, 1909 (Vol. II, p. 259), a review of our book, 'TICKS, A MONOGRAPH OF THE IXODOIDEA,' over the signature of N. Banks. We are the last to question the right of the reviewer to form and publish an unfavorable opinion of our work, and must bear with what philosophy we can the low estimate in which he holds it, but it is perhaps permissible to protest strongly against his distorted and misleading statement of facts. When the reviewer states that the work 'is not a monograph in any sense of the word,' we cannot but express our astonishment and would refer him to any English dictionary for a definition of the word monograph. Our copy of Webster defines a monograph as 'a written account or description of a single thing or class of things; a special treatise on a particular subject of limited range.' Perhaps Mr. Banks does not use a Webster's dictionary. When Mr. Banks states that we have not studied the collections belonging to Neumann nor those in Berlin and Paris he is making a statement about facts of which he has no personal knowledge, for we have received and studied specimens from all the three sources named. We have examined five out of the six valid species of *Argas*, and our descriptions are based upon our own examination of these species. Similarly, we have personally studied eight out of the eleven valid species of *Ornithodoros*. Consequently the reviewer's statement that a 'number of species known to Doctor Neumann are unknown to them . . . ' gives a false impression to anyone reading the review.

"In all cases we have given the fullest credit to other authors. The gratitude we receive at the hands of Mr. Banks is comprised in his statement that we give a 'brief technical description (in many cases more or less compiled).' Naturally compilation has been necessary, but to slur over the original matter in the book as does Mr. Banks is unjust. In compiling we have sifted little wheat from much chaff, and, wherever we have been able, we have added information acquired by ourselves. This work has entailed much labor, which we are confident

is appreciated in competent quarters. Our 'brief technical descriptions' to which Mr. Banks appears to object are intentionally brief. We do not believe in padding descriptions with useless detail, but seize upon the *essential* characters which, in our opinion, after a survey of the group, serve for the recognition of a species.

"With regard to the reviewer's concluding statement that 'most of the figures are taken from Neumann. The plates are original—,' we would say that there are 116 figures (not 114). Of the 116 figures 45 are original, 43 are reproduced, by kind permission, from Neumann's original blocks and 28 are from figures by other authors. Of the 9 figures on the 3 plates 6 figures are original and 3 are reproduced from other authors. Are we to accept this as an example of Mr. Banks' sense of fair play or of the scientific precision which characterizes his 'brief technical description' of our book?

"We fear that Mr. Banks has unfortunately transgressed the line of legitimate criticism . . . We regret that we have been unable to make anything of his descriptions of two species of *Argas*. That others have experienced a similar difficulty with his diagnoses appears from the fact that in 'Das Tierreich' (Lieferung 3, Acarina) while eight of his species of *Oribatidæ* are admitted as possibly valid, sixteen are relegated to the category of 'doubtful.'

"Yours truly,

"GEO. H. F. NUTTALL, *Quick Professor of Biology in the University of Cambridge.*"

Scientific Notes

Injurious June Beetles, *Anomala marginata* Fabr.—At the office of the state entomologist at Blacksburg, Va., a complaint was recently received from Patrick County, Va., to the effect that a large apple orchard was being damaged seriously by some leaf-eating insect and request made for an investigation. A visit on July the 14th, 1909, revealed the fact that a large number of the apple trees in this orchard had been partially defoliated by a species of June beetle. The orchard consisted of about thirty thousand apple trees, from three to eight years old. The damage done to this orchard was so extensive that a portion of it presented a dull brown, unhealthy appearance from a distance. The trees most seriously damaged extended over an area of probably one hundred acres. Some trees were damaged more than others; some of the smaller ones had but few leaves left.

There were about twelve grape vines in front of the manager's dwelling, small vines of two or three years' growth, that were entirely defoliated.

There were several hundred of these beetles on one apple tree in some

cases. Upon being disturbed these insects fall to the ground as though dead, but become active on reaching the grass under the tree.

Their feeding habit closely resembles that of the Rose beetle, only they do not appear to attack the fruit save in rare instances. They seldom fly and when they do their flight is only for a few feet, from one limb of the tree to the other.

But comparatively few of these insects were left on the above date as the manager states that they appear about the middle of June and leave about the middle or latter part of July.

Specimens sent to Dr. L. O. Howard were identified by Mr. Schwarz as *Anomala marginata* Fabr. They are very like the common "June bug" found during the summer season on blackberry bushes, feeding on the fruit, only they are about half the size. The male of this species seems to have the peculiar habit of hanging on to the female, clasping the posterior portion of her abdomen with his anterior pair of legs when not feeding. The male is somewhat smaller than the female, abdomen darker, thoracic segment more narrow and deeper green.

The examination of this orchard was made after two o'clock in the afternoon. The manager states that these insects have been doing some little damage for the past two or three years but had been much worse during the present season than ever before. An examination of the surrounding orchards in this locality was not made at that time but no other similar complaints were received at this office.

J. C. STILES, *Assistant Entomologist, Virginia Crop Pest Commission*

Insect Work on the Shade and Ornamental Trees in Brooklyn for 1909.—This year was the first one in the history of Brooklyn that the insect enemies of its shade and ornamental trees were controlled with a marked degree of success. This is due partly to the egg-destroying work of the previous years, partly to the additional equipment of gas spraying machines and the early spraying, but more than anything else to the better grades of spraying material employed. For many years past the spraying done in this city proved ineffective. The futile results were of common note, but the cause was unknown. Last year a few chemical tests with the arsenate of lead in use told the whole story. This year five other brands of lead, selected according to the tests recorded in Bulletin 214 of the N. J. Agric. Experiment Station, were employed and all proved efficient. Twenty-three thousand pounds of lead were used and over forty thousand trees were sprayed. The Tussock Moth, our worst enemy, and *Datana ministra* were the most numerous caterpillars. The elm-leaf beetle was very abundant, but was readily subdued by the early spraying and later by the oil emulsions applied at the base of the trees during the period of pupation. The scurfy and oyster shell scales were thickly infesting five thousand elms, and an application of whale oil soap at the rate of one pound to six gallons of water (suggested by Prof. John B. Smith) proved very effective. The Ailanthus and Cynthia moths and the bag-worm, though very numerous last season, were hardly seen this year. The few pupæ of these species all seemed to have been parasitized. The new pests which are becoming formidable are the linden borer (*Saperda vestita*) on the European lindens and the hickory bark borer (*Scolytus quadrispinosus*) on all species of hickories. The former is as yet not very serious and the injections of

carbon bisulphid together with the removal of the badly infested trees proved very serviceable, but the hickory bark borer is becoming the most dangerous enemy, threatening over a thousand trees in Prospect Park and sixteen thousand others in Forest Park. Every effort is being made to check its ravages.

J. J. LEVISON, *Arboriculturist.*

Control of the Codling Moth.—At the meeting of the American Pomological Society at St. Catharine's, Ontario, on September 15, Mr. L. CAESAR of the Ontario Agricultural College discussed studies made by him in the orchards of Jos. Tweedle at Stony Creek, Ontario, this year. He applied the first spray just as the blossoms dropped, June 4–7, but was delayed on the south half of the orchard until June 10–12 on account of high winds. At the latter date but few calyces had closed. Two pounds of arsenate of lead per barrel, a pressure of 140 pounds with a Friend pump and Friend nozzles at a 45 degrees angle were used. The spray was directed into the calyces and the trees were thoroughly drenched in an effort to lodge the spray in the lower calyx cavity. On the Spy, Jonathan and Van Deveer this was successful because the stamens stand wide apart, but on the Greening, Golden Russet, Red Astrachan and other varieties it was found impossible to penetrate the stamens with the spray. The second spraying was applied June 25 to July 2, when the eggs had been laid and some had been hatched. At this spraying self-boiled lime-sulfur mixtures, 8–8–50, with 2 pounds arsenate of lead, was sprayed with small aperture nozzles at 160 pounds pressure. On July 28 the trees were examined and on the north half, where sprayed June 4, 99% of the fruit was found uninfested, which was equally true of varieties in which the spray had not penetrated to the lower calyx cavity. Ninety-four per cent. was found clean on the southern half sprayed June 10. Many larvæ which had entered at the sides of the fruit were found to have died after entering. On September 13, when the second brood had entered the apples, the trees were again examined. On the north half 90% were perfect and there were no wormy calyces, while on the south half 75–80% were clean and there were some wormy calyces. Unsprayed orchards nearby had 50 to 100% wormy and the orchard sprayed had been 50% wormy the previous year. Two full broods occur in the Niagara peninsula.

E. D. SANDERSON.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

OCTOBER, 1909

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints of contributions may be obtained at cost. Minor line figures will be reproduced without charge, but the engraving of larger illustrations must be borne by contributors or the electrotypes supplied. The receipt of all papers will be acknowledged.—EDS.

Over a year ago the editor called attention to the advisability of publishing certain matter, particularly general notes, in the October and December issues, partly because it would limit the amount of material awaiting publication early the following year, and also on account of the gain to be derived in case discussion was desired. Our gatherings afford unique opportunities for the discussion of papers from a variety of standpoints. It would be most desirable if entomologists could acquire the habit of publishing, at least in abstract, certain types of papers which they wished to have discussed at a coming meeting. Announcements of investigations contemplated and methods to be pursued are especially appropriate, and we trust that something of the kind may be seen in the December issue. Such announcements and discussions, if they accomplished nothing else, would bring those following similar lines into closer touch and might result in extremely valuable coöperation.

An article on a preceding page discusses one method by which the economic entomologist may reach the public and opens a question of much importance to many readers. Some years ago Doctor Forbes placed himself on record as follows: "It is not the facts of entomology we discover, but those which we persuade the farmer, the gardener or the fruit grower to use diligently for the protection or the preservation of his crops which make our entomology economic." This statement is most emphatically true at the present time and the entomologist who does not present his results to his clientage in a convincing manner fails to perform a most important duty. The precise method must of necessity depend largely upon the character of the work performed and especially upon local peculiarities. Methods of great value in a community possessing small knowledge of general entomology may be entirely inapplicable to a group of well informed fruit growers or progressive men engaged in other lines of agriculture.

Demonstration work is particularly adapted to localities where there is very little interest in economic entomology. Practical experimental work in well-informed communities is most important, since such localities, whether special attention be given to publicity or not, in reality become university extension centers. This discussion might be greatly amplified and undoubtedly much of value would be derived therefrom if entomologists from different parts of the country would give us the benefit of their experience.

The advisability of making changes in the management of the JOURNAL is a matter likely to come up for consideration at the coming meeting. The JOURNAL PUBLISHING COMPANY was organized primarily to afford a ready means for the publication of the proceedings of the American Association of Economic Entomologists. There was no thought of monetary gain, either on the part of the company as a whole or by specially interested individuals. In fact, care was taken in drafting the articles of organization to prevent one or a group of individuals from securing control, since it was deemed wise to have a thoroughly representative organ. The JOURNAL COMPANY has demonstrated the possibility of issuing this serial without financial loss. The question has been raised as to the advisabilty of the association taking over the JOURNAL and have the membership fee (the latter raised to $2 for active members, $1.50 for associate members and $1.00 for foreign members) include subscription to the official organ. Every economic entomologist should possess a copy of this publication. The wisdom of this will become much more apparent in subsequent years. Some amendment to the by-laws would be necessary if the change is made. This can easily be arranged by the secretary giving thirty days' notice of the proposed amendments. This change would render a publishing company unnecessary, give the association direct control of its official organ and effect an economy in the collection of subscriptions.

Reviews

RECENT WORK ON THE CODLING MOTH.—Three recent reports of investigations of the codling moth have added very much to our knowledge of the life history and control of this pest in Arkansas, Virginia and Georgia. These studies confirm observations made by others on the following points: Practically all eggs of the first generation are laid on the leaves; a larger proportion of the larvæ of the second brood enter at the side and stem; the drenching spray shows no

greater efficiency at 100 to 120 pounds pressure than the mist spray; late spraying applied so that the foliage is covered when the first eggs hatch destroys the first brood of larvæ very effectively, although not as well as the spray directed into the calyx.

These studies, particularly the first, show a marked advance in exactness of method in the study of the life history and the care with which spraying experiments have been arranged and form a most important addition to our knowledge of the subject. With the data which has been recently presented from various parts of the country a complete monograph of the life history and the means of control of the codling moth may now be prepared for the country as a whole and careful comparison and study will reveal not only most interesting differences in life history due to different climatic conditions, which will have a practical bearing upon means of control, but will also undoubtedly furnish a most interesting biological study in connection with the effect of climate on the number of generations, hibernation, etc.

The Codling Moth in the Ozarks, by E. L. JENNE. U. S. Dept. Agric., Bur. Ent. Bull. 80, Part I, p. 32, figs. 8 (June 26, 1909).

Mr. Jenne gives a report of the life history studies commenced in 1907 at Siloam Springs, Benton County, Arkansas. The account of the life history given is the most complete and satisfactory study of the life history of the codling moth for a given locality which we have seen. The arrangement is admirable, the data is well presented and full and when compared with that of previous years shows the seasonal variation in the life history. The spring pupæ occur from March 1 to June 1, the length of the pupal stage decreasing with the advance of the season, and the moths emerge from March 31 to June 8, the maximum emergence being on May 12, about a month after the apple blossoms dropped. The life of a moth averaged about ten days and the eggs were laid three to five days after emergence. The first brood of eggs commenced on April 7, were abundant by April 27, and the last were laid May 27. Practically all the eggs were laid on the leaves. Eggs laid on April 19 hatched in 19.6 days; those laid May 10 hatched in 7.5 days. The first larvæ were found April 27, three weeks after the apple petals fell. In 1907 they were found on May 18, or six weeks after the petals fell. The majority of the larvæ entered the fruit during May, this being due to the concentration of the first brood due to the shorter period of pupæ and eggs as the season advanced.

The first cocoons of the first new brood of pupæ were observed May 27 and the last on July 15. In 1907 the first cocoon was observed on June 12 and in 1906 on June 5. The average life of the first brood of larvæ in the fruit was 23.8 days. 7.2 days elapsed between the time the larvæ leave the fruit and their pupation. Thus the first brood of pupæ overlap the spring brood twelve days. An average of 10.7 days is passed by the first brood of pupæ. It should be noted that Mr. Jenne uses the term "brood" in speaking of any single stage of the insect and the word "generation" to include all stages of the life cycle.

The first larvæ, pupæ and moths in the spring are termed the spring brood and generation respectively and the first generation commences with the eggs laid by the spring moths. This nomenclature is somewhat different from that which has usually been used in discussing the life history of the codling moth and may tend to confusion, but is here followed. The first moth of the first brood emerged June 8, whereas in 1907 it emerged on June 25, and in 1908 on June 19. The moths of this generation lived 6.2 days.

Summing up, the life of the first generation from the time of oviposition to the emergence of the moths required an average of 54 days. The second brood of larvæ began to leave the fruit July 15 and the last of them left the fruit early in September. The average time in the fruit was 24.6 days, while in 1907 it was but 18.1 days, though the conditions were somewhat different. After leaving the fruit 11.8 days passed before the larvæ pupated. Very few larvæ pupated after August 20. The pupal stage averaged 10.5 days and the time in the cocoon 20.4 days. The second brood of moths commenced to emerge July 25, were abundant in August and diminished through September. The life cycle of the second generation thus required an average of 49.5 days, which, with 5 days before oviposition, makes a total of 54.5 days, as against 49 days in 1907. The first eggs of the third brood were laid August 5 and the last October 16 from a moth emerging October 1. All eggs laid before August 28 hatched in 5 days. In September the length of the egg stage lengthened to the maximum time for those in the spring. The first larvæ of the third brood occurred August 14 and began to leave the fruit September 2, having been 24 days in the fruit. All of these hibernated.

A few larvæ failed to pupate early in the season, but of the first brood there were three and of the second brood four larvæ which hibernated without pupating. In 1907 out of 41 larvæ 5 of the second brood failed to pupate. In 1908 the majority did not pupate after August 20 and all hibernated after September first.

There can be no question as to the correctness of there being three broods for three generations were reared from four eggs laid May 4. The band records showed that there were five times as many larvæ of the second brood as of the first brood, but that the third brood was hardly larger than the first, due to the early harvesting of the crop. This is an important factor in the control of the codling moth in southern localities or where early fruit is grown, the importance of which has not been usually noted and was evidenced by the rather small percentage of infestation, but 50% of Winesap apples and 60% of Ben Davis being infested on unsprayed trees.

Life History of the Codling Moth in Virginia, by J. E. Buck. Va. Agr. Exp't Station Rept. for 1908, p. 54–89; fig. 33–53.

The life history has not been so carefully studied by Mr. Buck in Virginia, but the report gives very valuable data and undoubtedly presents the most important data concerning the life history from a practical standpoint. Further life history studies with a larger amount of material carried on at the different latitudes in Virginia would make a most valuable addition.

The effect of birds in the destruction of winter larvæ was studied and it was estimated that 85% were destroyed by them. The spring pupæ were found March 28 and most of the larvæ had pupated by April 28. The earlier pupæ required about 30 days. The first moth emerged April 26 and the last June

the maximum emergence being about the middle of May. One moth lived 17 days, but the average was from 2 to 7 days in jars. More eggs were observed on the fruit than have been noted elsewhere, 25 being found on apples against 50 on leaves on May 25, but this count is hardly large enough to be conclusive. Blossoms dropped about April 30 and the first larvæ were found in apples about June 2, though a few entered earlier. Seventy-one per cent. of the larvæ entered the calyx, 21% entered the side and 8% at the stem. The first brood of moths occurred from July 4 to August 28, the maximum being about the middle of July and the maximum of the larvæ found under bands was July 13. Eggs were laid on July 15, 15 being found on leaves, 10 on apples. These hatched in five days. Sixty per cent. of the second brood of larvæ entered the side of the apples. Pupation stopped about August 8. The band records taken at Blacksburg, latitude 37.25 degrees, altitude 2,170 feet, show maxima at June 28 and July 30, while at Emporia, latitude 36.45 degrees, elevation 200 feet, the maxima were June 6 and August 5. A fuller study of the life history at these two points would therefore undoubtedly reveal important differences, with probably a third brood at Emporia. The observations on the life history were made at Blacksburg.

Well arranged spraying experiments were carried out on York trees with well planned plots and with both dropped and picked fruit recorded. 70.9% of the fruit was wormy on checked trees. The results indicate that 4 ounces Paris green was not quite as effective as 1¼ pound arsenate of lead. Drenching the trees with Bordeaux nozzles with 100 to 120-pound pressure with a barrel pump showed no benefit over a mist spray. A pressure gauge was used and a constant pressure maintained. Plots 15 and 16 were in a separate orchard of Ben Davis and so were not comparable with the previous plots. They were sprayed two to four weeks after the blossoms dropped. Six ounces of Paris green seemed to be of equal value to 2 pounds arsenate of lead. With 41.52% wormy on the check trees there were but 2.12% and 4.29% wormy on the sprayed trees and 1.86% and 4.56% of the picked fruit wormy. This indicates that the later spraying gave practically as large a per cent. of good fruit as the earlier spraying directed into the calyx.

The Codling Moth or Apple Worm in Georgia, by W. V. Reed, Ga. State Bd. Ent. Bull. 29, March 15, 1909, p. 37; fig. 23.

Studies of the life history were made at Cornelia in 1906, Pomona in 1907, and Tallapoosa in 1908. In 1906 the spring brood of moths emerged, May 6 to 24, maximum May 12; in 1907 from April 25 to May 17, and in 1908 from April 9 to 26. These results are based, however, on but from 10 to 20 moths each season.

Eighty-nine per cent. of the first brood of eggs were laid on the foliage and 9% on the fruit in 964 eggs observed. The eggs of the first brood hatch in an average of 9 days. During July the second brood hatch in 5½ days. Mr. Reed has succeeded in rearing larvæ on leaves entirely and finds frequent evidence of their work on foliage in the orchard. Seventy-one per cent. entered the calyx, 16% the side, and 8% of the larvæ entered at the stems during the season. The average life of larvæ in the fruit was 28 days for the first brood, and from 13 to 36 days, averaging less than three weeks for the second brood. Most moths lived less than a week, though one lived 25 days, but he concludes that the average life is two to three weeks. Including 5 days from

emergence of moth to oviposition, the second generation requires an average of 48 days (35 to 65 days). A life history chart is given showing the development of three full generations and part of a fourth, this being based on continuous rearings throughout the season, but the discussion of the life history might well have been amplified. Mr. Reed concludes, however, that probably there are usually only three generations and sometimes only two and a partial third. Some larvæ of each brood fail to pupate and hibernate over winter.

Concerning spraying Mr. Reed states that on the proper time of spraying for the first brood hangs 78% of successful control for the season, although the second brood does more actual damage than the first brood.

Spraying experiments were carried on at Tallapoosa and Pomona. Unfortunately no records of dropped fruit were made and at Pomona only 500 fruit were counted from a single tree in each plot. The arrangement of the plots was also unsatisfactory, consisting of straight rows, side by side, so that there must have been considerable influence of one plot on another. Nor was the time of spraying well arranged to show the exact value of the early sprays after the first or the best time for their application. The first was given when the petals fell (April 6); second, before calyx closed (April 13); third, 10 days later (April 23); fourth, 14 days later (April 27); and fifth, when second brood eggs hatched (June 12); and two weeks later (June 26). Therefore the results of the spraying experiments can hardly be regarded as very conclusive, but studied in a broad way indicate the following results:

But little difference was indicated in the value of the first three sprayings, or whether applied just as the petals fell or a week later just before the calyx closed. Late sprayings for the second brood showed only 2 to 5% benefit, and when added to the early sprays increased their benefit by about the same amount. The practical value of spraying was well demonstrated, though the per cent. of perfect picked fruit was not as high as should be secured with thorough work.

E. D. SANDERSON.

Striped Cucumber Beetle, by T. J. HEADLEE, 19th and 20th Reports of the N. H. College of Agric. & Mechanic Arts, p. 419–513. 1908.

This is a most excellent general economic account of the striped cucumber beetle, one of the most important insects with which the American farmer has to deal. The writings of earlier authors are freely cited and comparisons are made, some of which are extremely interesting, *e. g.*, the periods the writer determined by rearing in the District of Columbia in a high temperature in comparison with those in New Hampshire at the naturally considerably lower temperature. In the former it was found that the pupal period could be passed in a minimum of seven days in a temperature of from 75° to 85° F., while in New Hampshire 13 days are required in a temperature of about 66° F. In regard to the total period of the life cycle, Garman, working in Kentucky, ascertained that this period from the hatching of the egg to the transformation to the adult averaged from 26 to 33 days, while in New Hampshire the life cycle was passed in an average of 54 days, at a mean temperature of 69° F. In New Hampshire it has been ascertained that the species is single brooded, but the writer still claims, until it can be otherwise proved, that there are at least two generations in the District of Columbia and perhaps three southward, this conclusion being based upon analogy. Some interesting

experiments were made with remedies, but there is still much to be learned on this line. In spite of the observations of Messrs. Sirrine and Headlee that this cucumber beetle is expert in avoiding poisoned portions of a plant, as good results have been obtained by others in the use of arsenate of lead as for the Colorado potato beetle. Trap crops are also valuable and additional experiments should be made with them. F. H. C.

Insect Friends and Enemies: The Relation of Insects to Man, to Other Animals, to One Another, and to Plants, with a Chapter on the War Against Insects, by JOHN B. SMITH, J. B. Lippincott Co., p. 1–134, 1909.

This popular work is a remarkably sympathetic and accurate discussion of the relationships between insects and their environment. The writer's extensive experience as a practical entomologist and his intimate knowledge of the literature have enabled him to produce a thoroughly modern and very readable and attractive book, covering certain fields which have not heretofore been adequately treated in popular literature. The various chapters, arranged largely along systematic lines, have for their chief purpose the exhibition of the numerous interrelations existing between the different insects and their relation to other organisms. The practical value of the book is greatly increased by numerous references to the more important injurious species for the purpose of illustrating the discussions. The chapters on insects in their relation to each other comprises a clear presentation of the value of parasites and incidentally summarizes certain recent biological discoveries. Birds come in for rather severe strictures on page 134, though the author admits their value under certain conditions and very properly regards them as but one of the natural checks on insect life. The treatment of insects in their relation to other animals, to man and the household is exceptionally full and is practically an economic discussion of the more important forms. The chapter on the war on insects is devoted mostly to insecticides and their application. The volume is illustrated with a large series of figures, taken mostly from the author's earlier publications, and an excellent plate (original) depicting in natural colors the chief insect pests of the household.

The general public will find in this volume a vast amount of interesting and valuable information respecting insects, while the investigator will frequently refer thereto because of the excellent summaries, especially of the recent investigations in regard to insects and their part in the dissemination of disease.

On Certain Seed Infesting Chalcis-Flies, by CYRUS R. CROSBY, C. Univ. Agric. Exp't. Sta. Bull. 265, p. 367–388. 1909.

This is an admirable investigation of minute, hitherto almost unnoticed forms, several of which are of considerable importance. A table showing the systematic position of the Phytophagous Chalcids is followed by historical, biological and descriptive accounts of several species, with special reference to methods of controlling the injurious or potentially injurious forms. The numerous illustrations are excellent and the author is to be congratulated upon making a substantial addition to our knowledge of this group.

Current Notes

Conducted by the Associate Editor

Prof. C. E. Sanborn has been appointed entomologist to the Oklahoma Agricultural Experiment Station. Address, Stillwater, Oklahoma.

Dr. A. W. Morrill, who has been engaged in White Fly investigations for the Bureau of Entomology in Florida, has resigned to become entomologist to the Arizona Horticultural Commission and the Arizona Agricultural Experiment Station.

Mr. Edward M. Ehrhorn, Deputy Commissioner of Horticulture of California, has resigned to accept the position of superintendent of entomology of the Hawaiian Board of Agriculture and Forestry. He took charge of the work at Honolulu October 1.

Mr. Jacob Kotinsky, who has been conducting the work since the death of the late Alexander Craw, resumes his post as assistant entomologist to the board.

Mr. M. M. High, a graduate of the Mississippi Agricultural College, has been appointed an expert in the Bureau of Entomology, United States Department of Agriculture. He will work on insects affecting truck crops.

Mr. S. S. Crossman, a graduate of the Massachusetts Agricultural College, has received the appointment of expert in the same bureau and has been detailed to work on White Fly investigations in Florida.

Mr. T. L. Patterson, a graduate of Clark College, Worcester, Mass., has been appointed an expert in the same bureau at the Gipsy Moth Parasite Laboratory, Melrose Highlands, Mass.

Mr. Dudley Moulton, who has been engaged in the investigation of deciduous fruit insects in California for the Bureau of Entomology, has resigned to become deputy commissioner of horticulture of California.

Dr. H. J. Franklin has resigned as assistant state entomologist of Minnesota.

The associate editor, owing to the editor being in Europe for several weeks, will edit the December number. It may save time to send all manuscript to the associate editor at the Gipsy Moth Parasite Laboratory, Melrose Highlands, Mass.

Mailed October 15, 1909.